A Dissertation on

"COMPARATIVE STUDY OF CONSERVATIVE AND OPERATIVE MANAGEMENT OF SOLID ORGAN INJURY IN BLUNT ABDOMINAL TRAUMA"

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THE TAMILNADU Dr.M.G.R. MEDICAL UNIVERSITY

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for the award of the degree of

M.S. GENERAL SURGERY

(BRANCH 1)

COIMBATORE MEDICAL COLLEGE,

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APRIL 2015

CERTIFICATE

Certified that this is the bonafide dissertation in **"COMPARATIVE STUDY OF CONSERVATIVE AND OPERATIVE MANAGEMENT OF SOLID ORGAN INJURY IN BLUNT ABDOMINAL TRAUMA"** was a work done by **Dr. S. VIMAL RAJ** and submitted in partial fulfilment of the requirements for the Degree of **M.S. General Surgery, Branch I** of The Tamilnadu Dr. M.G.R Medical University, Chennai.

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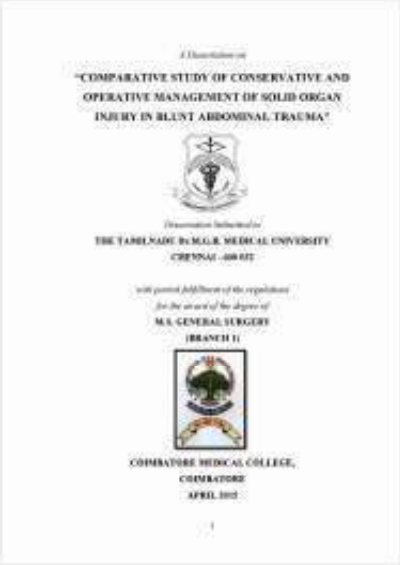

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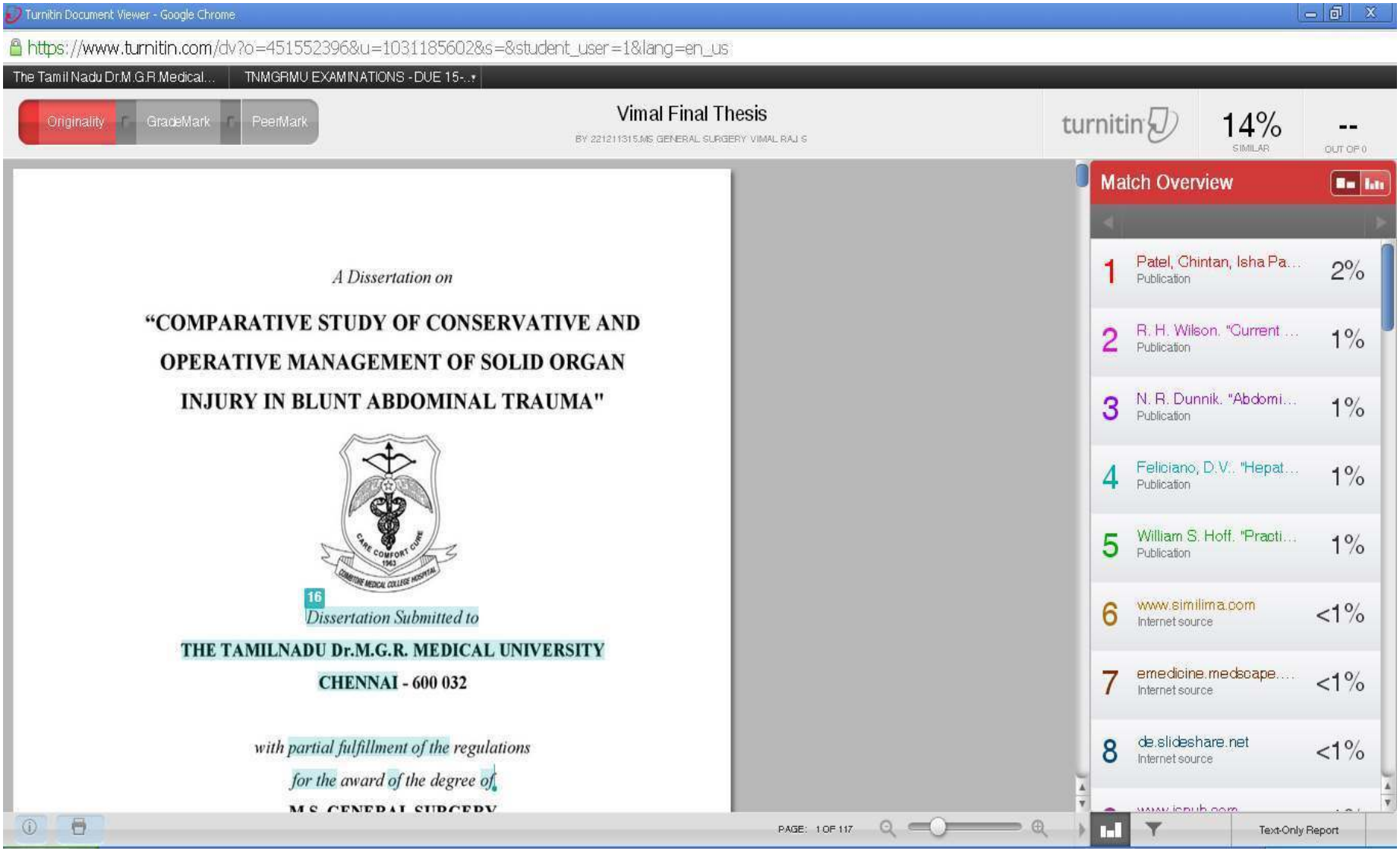
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DECLARATION

I Solemnly declare that the dissertation titled **"COMPARATIVE STUDY OF CONSERVATIVE AND OPERATIVE MANAGEMENT OF SOLID ORGAN INJURY IN BLUNT ABDOMINAL TRAUMA"** was done by me at Coimbatore Medical College and Government General Hospital during the academic year 2012-2015 under the guidance of **Prof.Dr.V.ELANGO M.S.** This dissertation is submitted to the Tamilnadu Dr.MGR Medical University towards the fulfilment of the requirement for the award of M.S. Degree in **General Surgery (Branch I).**

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PLACE : **Dr. S. VIMAL RAJ**

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LIST OF ABBREVATIONS USED

ARDS	–	Acute respiratory distress syndrome
A –V	–	Arterio venous
BIA	–	Blunt injury abdomen
CBD	–	Common bile duct
CECT	–	Contrast enhanced computed tomography
CHD	–	Common hepatic duct
CPR	–	Cardiopulmonary resuscitation
CUSA	–	Cavitron ultrasonic surgical aspirator
CVP	–	Central venous pressure
DPL	–	Diagnostic peritoneal lavage
ERCP	–	Endoscopic retrograde cholangiopancreatography
FAST	–	Focused assessment by sonography for trauma
FQA	–	Four quadrant aspiration
GCS	–	Glasgow coma scale
ICD	–	Intercostal drainage
ICU	–	Intensive care unit
IVC	–	Inferior venacava
IVU	–	Intravenous Urography
KUB	–	Kidney, ureter, bladder x ray film
MRI	–	Magnetic resonance imaging
RTA	–	Road traffic accident
USG	–	Ultrasonography

INTRODUCTION

Modern day have seen a tremendous improvement in mans life style and comforts. But along with comforts, serious challenging threats to human health has also been emerging . The technological advancement in the automobile industry and the vast increase in the use of automobiles have made motor vehicle accidents rank sixth among the leading causes of death[1] .

The rapid increase in the number of motor vehicles and its aftermath has resulted in very rapid increase in number of victims to blunt abdominal trauma. Motor vehicle accidents account for about 75 to 80% of the blunt abdominal trauma[2]. The indian fatality rates for trauma are 20 times more than that of developed countries . Most of the times blunt abdominal trauma is missed in the early phase of management. Blunt injury of abdomen is also a result of accidental fall from height, assault with blunt objects, industrial injuries, sport injuries, bomb blast and fall from riding bicycle[2].

Blunt abdominal trauma is generally not obvious. Hence, often missed, unless repeatedly examined. Due to the delay in diagnosis and inadequate treatment of abdominal injuries, most of the cases are

becoming fatal. The knowledge in the management of blunt abdominal trauma has been increasing progressively.

In spite of the best available techniques and advances in diagnostic and supportive care, the morbidity and mortality remains at large. The reasons for this could be due to the time interval between the trauma and hospitalization of the victim, inadequate and lack of appropriate surgical treatment, delay in the diagnosis, post operative complications and associated trauma particularly to head and thorax.

Spleen is the most common organ involved in abdominal injuries followed by liver. In case of patients with hemodynamic stability conservative management is the treatment of choice.

With CMCH being tertiary care centre and the availability of blunt injury cases in abundance, this study would serve to evaluate the modes of clinical presentations of various blunt abdominal organ injury signifying the precise management of various grades of splenic and liver injuries with reference to its post operative morbidity and mortality .

OBJECTIVES OF THE STUDY

The objectives of the study are:

1. To evaluate the pattern and outcome of blunt abdominal trauma with solid organ injuries using hemodynamic stability status ,USG and CT as parameters.

2. To evaluate various available investigations for the detection of solid organ injuries.

3. To compare conservative and operative management of blunt abdominal trauma.

4. To arrive at a treatment protocol for management of solid organ injury abdomen.

REVIEW OF LITERATURE

Selective history:

Blunt injury as causes of intra abdominal injuries have been recognized since historical times.

Aristotle was the first to record visceral injuries from blunt abdominal trauma.

Hippocrates and Galen are said to have given apt description of this condition[1].. By 1500 BC distinct triage and surgical protocol had been developed in Babylonia under the rule of Hummurabi as said by Edwin Smith Papyru.

The ancient Chinese used a sharp blow on the region of the spleen as a method of assassination. [3]

Trausse in 1827 presented fracture of body of pancreas in blunt tra uma.

Von Reckiling Huse described artery thrombosis occurring as a result of blunt trauma.

In 1906 Solomen performed peritoneal lavage for the first time.

In 1934 Aenhium used puncture of abdominal wall as a diagnostic procedure in abdominal injuries.

Branch in 1938 reported 2 cases of liver laceration treated by resection of left lobe.

Synthetic grafts was first used by Voorhes in 1952 and widely emp loyed by Hughes (1954) and Spencer (1955).

The development of emergency medical service is an important mil estone in the history of clinical and surgical practice of trauma. Greeks required physicians to be present during the battle and Romans established the hospitals close to the battlefield.[1]

Cincinnati General Hospital first instituted the ambulance system in 1865.

In 1965 Root first described the flushing of sterile solution through the peritoneal cavity to obtain peritoneal contents.

Advanced imaging techniques like spiral CT scan and MRI has made early detection of blunt abdominal injuries easier.

ANATOMY OF ABDOMINAL CAVITY:

Abdominal cavity extends just below xiphisternum to deep into the pelvis . Actually it is more extensive than the obvious abdominal cavity. Significant amount of abdominal cavity also projects into the pelvis . It has number of organs , some solid and other hollow viscous. Abdominal organs are protected anteriorly by muscles except those organs / parts lying under the lower ribs and in the pelvis . The abdominal cavity is bounded anteriorly by the rectus abdominis muscle , laterally by external, internal , transversis abdominis muscle and more inferiorly, the iliac muscles and posteriorly by the vertebral columns and psoas major , minor and quadrates lumborum.

It is divided into nine major regions for the descriptive purpose by two horizontal lines and two vertical arbitrary lines . The horizontal lines are transpyloric , at the level of pylorus of the stomach or passes through the tip of the ninth costal cartilage and that passing through the intertubercles of ilium as transtubercular line . The two vertical lines are from midclavicle downwards . The resulting quadrants are the right and left hypochondrium, the epigastrium, the right and left lumbar, the umbilical, the right and left iliac fossa and the hypogastrium

Arbitrarily the abdominal cavity can be divided into 4 areas

INTRATHORACIC ABDOMEN :

The intrathoracic abdomen is a part of the abdomen that lies beneath the rib cage. It contains the diaphragm, spleen, liver and the stomach. The clinical examination in this area is often difficult as these organs are covered by rib cage.

PELVIC ABDOMEN :

The pelvic abdomen is defined by bony pelvis. It includes urethra, urinary bladder, rectum, small intestine and in females uterus, ovaries and fallopian tubes. It is difficult to diagnose injury to these organs.

RETROPERITONEAL ABDOMEN :

The retroperitoneal organs include pancreas, kidney, ureter and major blood vessels, aorta and inferior vena cava. It is often very difficult to diagnose injury to these organs only by clinical findings. Therefore it requires other modalities of investigations like computed tomography, angiography and intravenous pyelography.

TRUE ABDOMEN :

And, finally the true abdomen which contains the small and large intestines, uterus and the bladder. Perforation of these organs is

associated with significant physical findings and usually manifests with pain and tenderness from peritonitis, thus easy to identify.

PERITONEAL CAVITY :

The peritoneum lines the abdominal cavity. It is a serous membrane Developmentally the abdominal and pelvic viscera invaginate into the abdominal cavity carrying the peritoneum before them . It is composed of outer fibrous tissue layer which gives strength and inner mesothelial layer which secretes fluid giving lubricating functions to the peritoneum. This results in the covering over of the organs by the visceral peritoneum and parietal peritoneum .

Parietal peritoneum lines the inner surface of the abdominal wall, under surface of the diaphragm and pelvic wall . It is loosely attached to the overlying walls and can be easily stripped off. It is innervated by the somatic nerves and so it is pain sensitive . The peritoneal cavity contains clear straw coloured fluid secreted by mesothelial cells of about 100 ml . Its quantity and quality differs in various pathological conditions.

The layers of opposing peritoneum between viscera and body wall and between two organs form visceral ligaments of the abdominal cavity . The disappearance , fusion , shifting , shortening of these peritoneal folds

during development divides the peritoneal cavity into two distinct parts, the greater sac and lesser sac. The lesser sac is situated posterior to lesser omentum, the stomach and the gastrocolicligament .Right side , it communicates with greater sac through the foramen of winslow . The structures within the abdominal cavity which are not suspended from the body wall by the mesentry or the ligaments are retro peritoneal in position. In males, peritoneal cavity is a closed cavity, whereas in females it communicates with the exterior through the openings of the fallopian tube at the fimbrial end.

LIVER

The liver is situated in the right upper quadrant of the abdomen.It is wedge shaped organ . The base of the wedge is directed to the right side. It is the largest gland in the body . It is the second largest organ in the human body , first being the skin . Its weighs about 1500 grams . It is pinkish brown in colour . It is soft in consistency with high vascularity . It is a very friable organ .

The anterior surface is triangular and is related to the xiphoid process and the diaphragm on either side . Above the diaphragm the pleura and lungs overlap the liver . The posterior surface of the liver is triangular and is marked by the vertebral impression in the middle . The

posterior surface is quadrilateral and is marked by the cardiac impression in the middle . The diaphragm seperates it from the pericardium and heart in the middle and from the pleura and lungs on each side . The inferior surface is also quadrilateral and has a sharp border .

The liver has two lobes . Right lobe , which has two additional lobes , the caudate and quadrate . Left lobe on the inferior surface presents the omentaltuberosity . The liver parenchyma is entirely covered by a thin capsule called glissons capsule and by visceral peritoneum in all , but not on the posterior surface of the liver which is termed as the bare area of the liver . It is held in position by various supporting structures such as falciform ligament ,ligamentum teres , anterior and posterior layers of coronary ligament and right and left triangular ligament

BLOOD SUPPLY :

It is a unique organ with dual blood supply . The hepatic blood flow is about 1500 ml / min . Liver receives about 20 % of its blood supply from the hepatic artery and about 80% from the portal vein ,Hepatic artery commonly originates from coeliac plexus. Hepatic artery ligation is one of the surgical palliation for advanced hepatocellular carcinoma and secondaries in liver , as tumour tissue is exclusively supplied by hepatic artery . But normal tissue is supplied by portal vein .

Before entering the liver the hepatic artery and portal vein divides into right and left branches . Within the liver they divide into segmental and then interlobular vessels which runs in the portal canal .

VENOUS DRAINAGE :

Venous drainage is from the three major hepatic veins right , left and middle hepatic veins which drains directly into the inferior vena cava . The bile is drained by the right and left hepatic ducts , which join to form the common hepatic duct . After joining the cystic duct the bile duct becomes common bile duct and drains into the second part of duodenum . Superior mesentric vein and splenic vein join dorsal to the neck of pancreas to form portal vein . Hepatic artery and portal vein and bile duct are located in free edge of lesser omentum until it enters the

Liver is divided into functional right and left lobes by a line passing from the left of the gall bladder fossa to the left of IVC – cantlies line creating couniads segment.

There are eight segments in liver. Segments 1 , 2 , 3 and 4 are of left lobe , Segments 5, 6 , 7 , and 8 are of right lobe.

Segment 1 is the caudate lobe of the liver and has independent blood supply of portal and hepatic veins . The hepatic vein directly joins

the IVC . Functional unit of liver is called as hepatic lobule and it contains central hepatic vein and portal triad (hepatic arteriole , portal venule , bile ductule).

PANCREAS :

Pancreas is also called as the abdominal tiger. Pancreas lies obliquely on the upper part of the posterior abdominal wall extending from the concavity of the duodenum to the spleen. It is an elongated retroperitoneal organ which has both the exocrine and endocrine functions. It is 15 to 20 cms in length. It lies against L1-L2 vertebrae. It lies posterior to the stomach separated by the lesser sac.

***RELATIONS*:**

Anteriorly it is related to the transverse colon and the stomach. Posteriorly, to the aorta, the inferior vena cava, the superior mesenteric artery and the left crus of the diaphragm.

The pancreas is divided into head, neck, body and tail. The head lies in the concavity of the duodenum and tail reaches upto the hilum of the spleen. The posterior surface of the neck of pancreas is related to the terminal part of superior mesenteric vein and the beginning of the portal

vein. The pancreas drains its secretions through the main and accessory pancreatic ducts.

Duct of Wirsung, the main pancreatic duct begins in the tail of pancreas and runs on the posterior surface of body and head of pancreas. It joins the bile duct in the wall of the second part of duodenum to form hepatopancreaticampulla of Vater and opens on the summit of major duodenal papillae.

Duct of Santorini, the accessory pancreatic duct begins in the lower part of the head of pancreas and opens into the duodenum at minor duodenal papillae.

The blood supply of the pancreas is from pancreatic branches of the splenic artery and superior and inferior pancreaticoduodenal artery.The venous drainage is into the portal vein.

Parasympathetic nerve supply is from Vagus and the sympathetic innervations is from splanchnic nerves.

Exocrine pancreas secretes pancreatic juice which helps in the digestion of the proteins, carbohydrates and fats. Endocrine parts constitutes the islets of pancreas which is distributed more numerous in

the tail of pancreas. Beta cells of pancreas secretes insulin. Alpha cells secrete glucagon.

SPLEEN :

Spleen is a wedge shaped organ which lies in the left hypochondric region of the abdomen, its long axis being parallel to the 9^{th}, 10^{th} and 11^{th} ribs, behind the stomach and inferior to the diaphragm. It is highly vascular and reddish purple in colour. Hilum of the spleen transmits splenic vessels and nerves. The visceral surface of the spleen is related to the stomach, the splenic flexure of the colon and the kidney. It is a lymphatic organ connected to the vascular system.

Spleen is palpated under the left costal margin during inspiration.It has to enlarge 2 to 3 times its normal size to become palpable. The healthy spleen is not usually palpable. The spleen has got two ends, the anterior and the posterior ends. The spleen has got three borders, the superior, the inferior and the intermediate. The superior border of the spleen contains the splenic notch. The spleen contains two surfaces namely the diaphragmatic and the visceral surfaces. The largest impression of the spleen is concave in nature and is created by the fundus of the stomach. Other impressions which are found in the spleen are renal impression, the colic impression and the pancreatic impression.

Splenic artery is the branch of the celiac artery but may arise from aorta or the superior mesenteric artery. Blood flow is about 300 ml/min. Splenic vein joins the superior mesenteric vein at right angles behind the neck of the pancreas to form the portal vein.

Spleen is surrounded by peritoneum and suspended by the following ligaments[3,4].

1. Gastro-splenic ligament from hilum to the greater curvature of the stomach which contains the gastric vessels.

2. Lienorenal ligament from the hilum to the anterior surface of the left kidney which transmits the blood vessels to the spleen. The tail of the pancreas lies in this ligament which may be damaged during splenectomy.

3. Phrenicocolic ligament supports the anterior end of the spleen. Splenic artery, a branch of the celiac artery supplies it. This may be damaged during mobilisation of the splenic flexure of colon.

Kidneys and suprarenal gland:

Kidneys are a pair of retroperitoneal excretory organs situated on the posterior abdominal wall one on each side of the vertebral column 14. The right kidney is slightly lower than the left kidney, and the left kidney

is a little nearer to the median plane compared to the right kidney .The kidneys are bean shaped organs and the weight of each kidney is about 135 to 150 grams. It is about 10 to 12 cm in length , 2 to 3 cm in thickness and 5 to 7 cm in width. Each kidney has got two poles, two surfaces and two borders . The upper pole of the kidney is broad and is related to suprarenal gland.The lower pole of the kidney is pointed. Lateral border is convex and the medial border is concave,with hilum in the middle. 3,4 .Anterior surface is highly irregular and posterior surface is flat.

RELATIONS: right kidney is related to right suprarenal gland, the second part of the duodenum, hepatic flexure of the colon and the small intestine.The left kidney is related to left suprarenal gland, stomach, pancreas, spleen, splenic vessels, splenic flexure, the jejunum at the descending colon . Posterior surface of both the kidneys are related to diaphragm, the two arcuate ligaments medial and the lateral, psoas major, quadratuslumborum,transverse abdominis muscle, subcostal vessels and the subcostal,iliohypogastric, and ilioinguinalnerves. Renal fascia (Gerotas) is the fibroareolarlayer surrounding the kidney and Perirenal pad of fat.

The kidney receives about 20 % of the cardiac output . the arterial supply of the kidney is from from renal arteries which are paired arteries, at the level of L 2. Renal artery enter into renal hilum , with renal vein anteriorly and renal pelvis posteriorly.

PATHOPHYSIOLOGY:

Several pathophysiological processes take place in a case of blunt abdominal injury. Understanding the mechanism of injury is very important in the management of a patient with blunt abdominal trauma. In general, injuries can be classified as high energy or low energy.

1. Blunt trauma causes damage from a combination of shearing, bursting and compression forces. Sudden, pronounced increase in the intra-abdominal pressure created by outward forces can cause rupture of the hollow viscera or can cause burst injury of the solid organs.

2. Compression of the abdominal organs between the applied force to the abdominal wall and the posterior thoracic cage of the vertebral column can produce crush injury.

3. Abrupt shearing forces can cause a tear of vascular pedicles or abdominal organs .

4. Oblique forces and deceleration injuries can cause shearing of viscera where anchored such as at the duodeno jejunal flexure and the peritoneal attachment of the bowel.

5. Deceleration injuries occur in high speed motor vehicle accidents and in cases of fall from height. On impact, the organs continue to move forward at the terminal velocity, tearing the organs at their site of attachment.

CLINICAL EXAMINATION :

HISTORY AND PHYSICAL EXAMINATION :

When a patient comes to the casualty with the history of blunt abdominal injury, the first and foremost priority should be to maintain airway, breathing and circulation and to treat pneumothorax and to arrest the internal bleeding. After resuscitation, a brief but detailed history taking should be obtained from the attenders, police or the bystanders.

Motor vehicle accident is the common cause of the blunt abdominal injury.The mechanism of injury and the position of the victim should be sought to know the probable intra abdominal injuries, where the accident was a pedestrian accident or if it was head on vehicles collision, the position of the victim(driving or pilon driver) , whether the

victim was wearing a seat belt should be noted. Patient's level of consciousness , the influence of alcohol should be obtained.

SYSTEMIC EXAMINATION :

HEAD INJURY :

The major factor that determines the survival and functional outcome in most cases of the blunt trauma of abdomen is the presence of the head injury. The severity of head injury can be rapidly assessed by determining the level of consciousness, lateralized weakness of the extremities and the pupillary symmetry.

Level of consciousness is best assessed by the GCS score(Glasgow Coma Scale) a scoring system that evaluates eye opening, motor response and the verbal response. The GCS is determined by taking the best response in each category and totalling the responses. It ranges from 3 to 15.

CHEST :

The patient should be undressed completely. Careful and complete inspection of the thorax should be done . Shape, size, symmetry and corresponding movements of both the hemithorax should be noted. Any abrasions, contusions, dilated veins, external wounds, bulging or

retraction of intercostal spaces, wound communicating with the peritoneal cavity should be noted. Trachea should be palpated for trail's sign. On percussion, dull note indicates hemothorax, hyper resonant note indicates pneumothorax. Liver dullness and cardiac dullness area should be noted carefully .

Respiratory system should be auscultated for type of respiration, type of breath sounds(bronchial/vesicular/bronchovesicular) and for added sounds like crepitations and ronchi. The cardiovascular system should be auscultated . In early cardiac tamponade distinct or muffled heart sounds may be an early clue to the diagnosis.

ABDOMEN :

The voluntary muscle guarding in trauma patients will disappear on expiration. The muscle guarding usually corresponds to the area of tenderness. Tenderness of the abdomen may be due to parietal haematoma, contusion or due to intra abdominal injuries. Rebound tenderness usually indicates peritoneal irritation. Genaralised distension of the abdomen is usually a late feature of genaralised peritonitis. The iliac crest and pubic symphysis should be compressed to establish the possibility of a pelvic fracture[20] .

Auscultation of the abdomen offers little in the trauma patients. However , presence of the bowel sounds in the chest indicates rupture of the diaphgram. The silent abdomen (absent bowel sounds) is a pathognomonic feature of diffuse peritonitis.

External genetalia and the rectum should be thoroughly examined for any rectal injuries .On rectal examination sphincter tone , integrity of bowel wall and blood staining should be noted . High riding prostate clinch the diagnosis of post membranous rupture of urethra .

CARE OF THE VICTIM AT THE ACCIDENT SITE:

Resuscitation of the patients and emergency transportation to the higher trauma centre should be done as early as possible . Paramedical staff accompaniying the ambulance should be well trained to resuscitate and to shift the patient to regionalised trauma centre. Mortality is usually decreased if the patient is diagnosed and operated as early as possible[6].

At the site of accident , the following measures should be undertaken to stabilise and prevent further damage to the patient . Goal of first aid at the accident site should be to prevent second , hypoxia and circulatory failure.

1. Ensure the normal airway and ventilation with endotracheal intubation
2. Arrest external bleeding
3. Start Intravenous fluids
4. Provide pneumatic anti shock garments
5. Protection of spine and splinting of fractures

Administration of intravenous fluids and pneumatic antishock garments are subject of controversy because these procedures may delay the transport of the patient to hospital.

GOLDEN HOUR IN TRAUMA :

It is also called as golden time in trauma patients . The term was first coined by DR. Adams cowley was the first person who promoted this concept . It refers to the time period lasting for the initiation of treatment to the patient and resuscitating the patient . It usually lasts for about one hour .

It is the time during which prompt medical treatment will prevent the death of the patient . If the patient recives the treatment during this period of time the chances of survival is better .

INITIAL RESUSCITATION OF PATIENTS AT CASUALTY

Injured patients may have involvement of multiple injuries.

The goals of management are in the order of priority.

1. To save the life
2. To save the limb.
3. To minimise the disability.
4. Cosmetic care of the patient.

ADEQUATE AIRWAY

This is the first and foremost important emergency measure of a severely injured patient at the site of accident .The airway is maintained by chin lift, jaw thrust. The airway may be either oral airway (in case of unconscious patients) or nasal airway.[23] Provide airway by endotracheal intubation using laryngoscope or by surgical intervention either by needle cricothyroidectomy or tracheostomy. An emergency room should always be provided with a laryngoscope and cuffed endotracheal tubes of different sizes. Endotracheal intubation is the most rapid method of securing an adequate airway. ET tube is connected to an ambu bag for positive pressure ventilation. Either wall suction or a portable suction

machine should always be available in the emergency room to remove foreign bodies, pulmonary secretions and frequently blood clots from the upper respiratory tract.[12]

BREATHING :

This implies ensuring ventilation, perfusion and good pulmonary circulation. It will be disturbed in cases of rib cage injury, pleural collections, tracheo-bronchial injuries or in patients with lung contusions, metabolic disturbances and in ARDS. Provide supplemental oxygen either by mask or nasal catheter at a rate of 8 lit/min. Chest defects should have to be stabilised. Assist the ventilator effort to maintain normal respiratory rate, rhythm and arterial blood oxygen and CO_2. Pleural space collections like air or blood have to be evacuated by aspiration or intercostals drains connected to underwater sealed systems.

CIRCULATION :

Generalised hypo-perfusion usually results from oligemic shock or underlying cardiogenic, endotoxic and neurogenic shock. Localised limb hypoperfusion following injured blood vessel may lead to tissue destruction and gangrene of affected limb or organ. Prevent further blood loss by direct pressure over injured area. Replace fluid losses by keeping the patient in Trendelenberg position, auto-transfusion or by whole blood

transfusion. IV infusion should be started in two lines. Correct acidosis by injecting sodium bicarbonate.[24] Monitor sensorium, pulse rate, urine output, electrocardiogram and CVP (if facilities are available). Shock is usually controlled while the patients' airway is controlled by another person. Active internal bleeding will require immediate surgical intervention. A balanced crystalloid like Ringer lactate is usually started until blood is available. Blood for grouping, typing and cross-matching is also withdrawn. Response to the therapy is monitored by skin perfusion, urinary output and CVP readings.

DISABILITY/NEUROLOGICAL ASSESSMENT

After securing the airway and hemorrhage has been controlled, a gross neurological evaluation has to be undertaken. The level of consciousness, pupillary response and motor function of all the extremities must be assessed. A progressing neurological deficit usually following injury to the spinal cord may indicate the necessity for an emergency laminectomy. The pupillary response can even be assessed in paralysed patients.

After having treated the victim for most of the life-threatening injuries, the next step is to re-examine the patient for diagnosing other injuries. Complete physical examination is typically done in a head to

foot manner. All necessary radiological and laboratory investigations have to be done and reports have to be collected. The current diagnostic techniques in assessing abdominal injuries are discussed below.[25]

Diagnostic methods

The following are the useful diagnostic methods in blunt abdominal trauma.

1. Four quadrant abdominal tap:

Simple needle aspiration has been used for a very long time to diagnose blunt abdominal injuries. Aspiration by a large bore needle (size of 18G) is done in four quadrants in right and left hypochondrium as well as in right and left iliac fossa. The accuracy of four quadrant aspiration is about 80 % but it is argued to cause inherent risk of visceral injuries. However a negative tap does not rule out hemoperitoneum.

2. Focused Abdominal Sonography for Trauma (FAST):

As the quality of the ultrasound machines have become portable, there is an increasing trend of FAST application in initial evaluation of blunt abdominal injury. Ultrasound abdomen can demonstrate the presence of free intraperitoneal fluid (hemo peritoneum and peritonitis) as well as the extent and precise location of the solid organ hematomas. Of

late, FAST has emerged as a useful diagnostic tool in the evaluation of blunt abdominal injury. [21] FAST is a noninvasive test and may be easily performed and can be done concurrently with reuscitation of the patient.

In addition this, the technology of FAST is portable and may be easily repeated in necessary situations. In most cases, FAST may be don within 3 or 4 minutes. A particular draw back to the FAST is the fact that a positive examination relies mainly on the presence of free intraperitoneal fluid. FAST will detect a minimum of about 200 mL of free fluid.

Injuries not associated with hemoperitoneum may not be detected by FAST. FAST examination cannot be used to reliably grade the injury to solid organs. Therefore, in case of hemodynamically stable patients, a follow-up CT scan have to be obtained if conservative management is contemplated. In the hemodynamically stable patient with blunt abdominal trauma, FAS Toffers aviable alternative to the DPL.

3. Plain radiography and contrast studies:

Radiological procedures in a stable patient with blunt abdominal trauma may be helpful especially when the physical examination and labarotary values are in conclusive. Plain x-ray abdomen have to be done before other invasive investigations such as paracentesis, in order to

avoid the confusion in detection of air under the diaphragm. A plain x-ray should include AP view chest, supine view of abdominal and erect abdominal view or left lateral decubitus view, if the patient cannot stand.

Chest radiograph will be very useful in detecting thoracic and diaphragmatic injuries. Air under the diaphragm will be a common finding in patients with gastric, duodenal, small intestine and colonic perforations. Presence of rib, pelvic, vertebral body and transeverse process fractures can also be made out in plain xray. Common findings in case of blunt trauma would be air under the diaphragm , presence of air fluid levels

The following supporting evidence maybe observed.

The flank stripe sign:

It is a fluid dense zone separating the ascending or descending colon from the distinctly outlined lateral peritoneal wall and pushing the colon medially.

The dog ear sign

It results from the accumulation of the blood between the pelvic viscera and the sidewalls of each side of the urinary bladder.

The hepatic angle sign:

It is the loss of the definition of the usually clearly defined inferior and right lateral borders of the liver as blood gets accumulated between the hepatic angle and the right peritoneal wall. Hemoperitoneum also causes small intestine to shift towards the centre of the abdomen with the production of ground-glass appearance.

Mal positioned nasogastric tube is often the first sign of a ruptured left diaphragm. Mediastinal shift to the side opposite to that of injury, presence of bowel loops above the diaphragm are also seen.

In case of ruptured duodenum both intra and retroperitoneal x ray studies are needed for diagnosis . Free air or retroperitoneal air will be demonstrated in the film as water soluble contrast will delineate the site of rupture. Intramural hematomas at the site of duodenum can be diagnosed by plain and contrast films.

In case of pancreatic injuries, enlargement of pancreas will show widening of the duodenums weep impression over the posterior aspect of stomach, separation of stomach from the transverse colon and the depression of the transverse colon can be well visualised. Impression on the splenic flexure gas shadow termed as the colon cutoff sign is also seen. Left margin of the psoas may blurred.

4. Diagnostic peritoneal lavage (DPL):

Diagnostic peritoneal lavage was first introduced by Root et al in the year 1965.This is a rapid, inexpensive, accurate and relatively safe diagnostic modality in the management of patients with blunt abdominal trauma.[6]

Indications for performing a DPL:

- Signs those are equivocal or obscured by adjacent soft tissue injury masking the signs.
- Unreliable signs because of head injury, paraplegia or intoxication.
- Signs which are difficult to assess if the patient is undergoing lengthy unexplained severe hypotension or blood loss, even if the abdominal examination is normal.

Only absolute contraindication to DPL is a clear cut indication for an emergency.

There are three methods of doing DPL:

1. Closed method.
2. Open method.
3. Semi-open method. Semi-open method is commonly used technique:

Insert a nasogastric tube and urinary catheter and the abdomen is prepared using antiseptic solution Infiltrate local anesthetic in the midline below the level of umbilicus. Make a 4 cm midline incision down deep to the fascia. Incise the fascia and peritoneum and grasp the peritoneal edge with clips. Insert a peritoneal dialysis catheter or a infant feeding tube. Aspirate contents with a syringe looking for blood or bowel contents.

After that instill 1 liter of warmed 0.9% sodium chloride (10ml/kg body weight) and distribute gently by agitation of the abdomen if the condition of the patient permits to do it. Drain off the fluid after 5-10 mins depending on the degree of urgency. Minimum 75% of the lavage effluent is required for the test to be valued. The aspirated fluid is analyzed in the laboratory by macroscopic, microscopic and biochemical evaluation.

Table 1. Criteria for diagnosing the peritoneal lavage following Blunt abdominal injury.

Index	**Positive**	**Equivocal**
ASPIRATE		
Blood	>10ml	>5ml
Fluid	Enteric contents	
LAVAGE		
RBC	>1 ooooo cells /mm3	>500000cells/mm3
WBC	>500 cells /mm3	>200 cells/mm3
Enzyme	Amylase:>20IU/l Alkaline phosphatase >3IU/l	
Bile	Confirmed biochemically	

5. Computarized tomography of abdomen (CT scan):

It plays an very important role in the evaluation of patients with blunt abdominal trauma when applied in appropriate setting. . Four groups of patients are particularly suitable for CT scanning:

1. Patients who presents late (<12 hours) and are hemodynamically stable and do not have any overt signs of peritonitis.

2. Patients in whom DPL results are found to be equivocal and the results of repeated physical examination are unreliable .

3. Patients with difficulty in performing DPL (eg: morbidobesity, late term pregnancy or multiple previous abdominal surgeries), peritoneal adhesions in previous laprotomies pose a technical problem to placement of DPL catheter

4. Patients who are at risk for retroperitoneal injuries in whom the DPL is unremarkable.

Advantages:

- It is an excellent means to diagnose intraperitoneal bleeding .
- It gives different and excellent views of spleen and liver permitting exact diagnosis of solid viscus injury.
- It is also very useful in the diagnosis of retroperitoneal injury.
- Stomach, duodenum and pancreas can be diagnosed with higher degree of accuracy.
- Intravenous contrast permits excellent imaging of the Kidneys and whole urinary system.

Disadvantages:

- The retroperitoneal colonic injury is delineated very rarely .
- CT scan is poor for making the diagnosis of hollow viscus injuries and pancreatic injuries which are early. Requires a proper set up

and proper interpretation of films by experienced radiologist.

- It takes a minimum of about 45-60 minutes to do CT and it is difficult to monitor the patient during the investigation.

- CT will detect hemoperitoneum of more than 100 ml.

6. Radionuclide imaging:

This is a non-invasive isotope study and makes it attractive as a screening procedure. There is reduced radiation exposure and it permits repeat and follow up studies with safety. But the main disadvantage in radio nucleotide is that , they are not always freely available in most centers and is also dependent on the availability of an expert radiologist.

7. Arteriography:

The main tool prior to CT scan and ultrasound is arteriography. Its use is now limited for the diagnosis of solid organ injury in intra abdominal injuries and arterial bleeding in patients with fracture pelvis. Therapeutic embolization can be carried whenever necessary. Abdominal aortography or Visceral arteriography is very useful in the diagnosis and management of intra abdominal bleeding in blunt abdominal trauma. Contraindications to do arteriography is obvious need for laparotomy, unstable patients or people who are allergic to the contrast agent. The

primary use is to prevent negative laparotomy.[6]

8. Laparoscopy or diagnostic laparotomy:

It is the final court of appeal in diagnosing blunt abdominal injuries. It has distinct advantage over a paracentesis because it provides direct visualization of the site and extent of the bleeding.

9. Enzymes studies:

Amylase and alkaline phosphatase levels of the fluid from DPL when equal to or greater than the serum level is suggestive of bowel injury or injury to liver or pancreas. Routine investigations ; complete blood count with hematocrit, blood grouping and typing, serum Amylase and alkaline phosphatase, complete urine analysis, blood urea, serum creatinine, blood sugar, chest X ray and ECG have to be done.

9) CENTRAL VENOUS PRESURE:

It refers to the pressure in the central veins when they enter the the right atrium . CVP indicates only pressure and it is not a indicator of volume . It is usually measured in end expiratory state .The normal CVP is 3 to 8 mm hg.

Indications:

Monitoring and guiding fluid management in critically ill patients

Diagnostic measurements

Elevated CVP :

Hypervolemia

Tension pneumothorax

Heart failure

Cardiac tamponade

Decreased:

Hypovolemia

Deep inhalation

Distributive shock

MANAGEMENT OF INDIVIDUAL ORGAN INJURIES:

LIVER INJURIES:

Incidence:

The liver is the second most common organ to get injured in all patients with blunt abdominal trauma with spleen being the first organ. Incidence of liver injury is about 35-45% in blunt abdominal trauma , 40% in stab injury abdomen and 30% of in gunshot wound to the abdomen.

Mechanism of injury:

Blunt injury may results from direct blow to the abdomen, compression between the lower ribs and the spine on the right side or shearing forces at fixed points secondary to deceleration injury .

Table 2. Classification of liver injuries (organ injury scaling system) 2 GradeInjury description

i. Hematoma: sub capsular, <10% surface area of liver.

   Laceration: capsular tear, <1cm parenchymal depth.

ii. Hematoma: subcapsular, 10-50% surface area of liver.

   Intraparenchymal hematoma ,<10cm diameter.

   Laceration: capsular tear 1-3 cm parenchymal depth, <10cm long

iii. Hematoma: subcapsular, >50% or expanding hematoma ; ruptured Subcapsular or parenchymal hematoma; intra-Parenchymal hematoma >10cm or expanding.

   Laceration: capsular tear >3cm parenchymal depth.

iv. Laceration ; liver parenchymal disruption involving 25-75% of hepatic lobes or couinaud's segments 1 – 3 (within a single lobe).

v. Laceration: parenchymal disruption involving >75% of hepatic lobes or >3 couinaud's segments (within a single lobe).

vi. Vascular : juxtahepatic venous injuries (i.e.inferior venacava/ major hepatic veins).

vii. Vascular: hepatic avulsion.

Clinical manifestation :

Major hepatic injuries are usually easy to detect because of the location of abdominal trauma, profound hypotension, temporarily responsive to the infusion of colloid and crystalloids and marked abdominal distension. Very Small hepatic tears from blunt abdominal trauma or small lacerations from the stab wound are usually more difficult to detect as bleeding from such injuries may be very limited and might have stopped by the time the patient reaches the emergency centre.

Investigation:

1. A very low hematocrit value.

2. Diagnostic peritoneal lavage (DPL): A positive peritoneal lavage is non-specific to the site and the magnitude of injury. Accuracy of DPL is about 95%. DPL may be useful in conditions where physical examination is unreliable such as altered mental status due to head injury or drugs, including alcohol.

3. CT scan: CT scan can identify specific injury such as disruption of liver architecture and intrahepatic bleeding, subcapsular or intra hepatic hematoma and peri hepatic bleed . The correlation of the extent to which liver is injured found by CT and that found at the time of laparotomy may not correlate, with instances of both over and under estimation. Despite this limitation, CT has clearly become the gold standard investigation among the imaging modalities available for diagnosis of hepatic trauma. In the modern era of selective non-operative therapy, clear knowledge about the nature of the hepatic injury is essential in the selection of the therapy.

4 Ultrasound(FAST) ; It can reveal a breach in the liver contour and disruption of normal architecture of liver . Fluid in the peritoneal cavity that is presumed to be blood may be visualized around the liver. It can be used as a screening procedure.

5 Radio isotope scanning: may show filling defect within the hepatic substance due to intra parenchymal hematoma, a fracture of liver may result in a contour defect on the isotope scan.

6 Arteriography: it outlines an intra-hepatic hematoma, extravasation of dye or a fracture of the liver, but non invasive techniques can also provide the same information.

7 Laparosopy: It is diagnostic in hepatic injuries.

Management:

Resuscitation:

Approximately 80% of all the patients who die of hepatic injuries in the perioperative period is mainly from bleeding and hypovolemic shock. Profound hypothermia is frequently present when there is severe hepatic injury, particularly after repeated transfusions of non warmed blood.

The most important resuscitative technique in the patient with a major hepatic trauma includes insertion of large bore IV cannula, rapid transfusion of warm crystalloid solution and colloids (blood) and early laprotomy for controlling of ongoing bleeding.

Principles of operation:

Incision: The upper abdomen is best explored in cases of blunt trauma through a upper midline incision. If on exploration, hepatic vein injury is suspected, exploration of the region of hepatic veins should not be attempted through the abdominal incision. If patient improves and exposure of the superior and posterior surface of the liver is required,a combined right sided thoraco-abdominal incision is usually needed. If the peritoneal cavity is found to be contaminated with fecal contents,

extension of the abdominal incision into the chest is done only under life threatening conditions.

Initial evaluations: The presence of clots and blood in the right upper quadrant may signal the presence of a hepatic injury. Once these clots are removed, the inspection and palpation may identify the fracture or disruption of hepatic parenchyma. In the absence of other associated abdominal injuries, attention is directed to the hepatic injury.

Management of actively bleeding liver:

Various techniques are:

Manual compression:

Once the peritoneum is entered and serious bleeding is encountered, manual compression is the first essential life saving maneuver the surgeon should attempt which is applied from right and left margins of the liver towards the center. At the same time, a posterior directional force may help to arrest the bleeding in the retrohepatic surface and the posterior perihepatic space.

Portal triad occlusion:

The Pringles maneuver is usually the first step in attempting to stop bleeding in hepatic artery particularly if there appears to be arterial

component, by means of artery occlusion. The left thumb is first placed over the anterior surface of the hepato-duodenal ligament and with the middle and index finger inserted into the foramen of Winslow (epiploic foramen).The structures in the porta hepatis are compressed until a vascular clamp is placed across the portahepatis. The results are observed in 10 minutes. The wound is examined and the bleeding source is identified. Vessels and bile ducts that are visualized are occluded by clips, ties or by fibrin glue.

Selective hepatic artery ligation:

It is done when selective clamping of the extra lobarhepatic artery causes cessation of arterial bleeding in a hepatotomy site orparenchymal laceration and the injured vessel is not clearly visualized inside the liver. Either the right or the left hepatic artery is ligated. If the right hepatic artery is ligated, cholecystectomy is necessary to prevent gangrenous cholecystitis.

Perihepatic packing:

This technique involves the insertion of laparotomy pads or rolls of gauze around the injured liver (not into the hepatic lacerations) i.e. between the diaphragm and the liver, below the liver and laterally until sufficient amount of pressure is generated to achieve hemostasis.

Excessive packing should not be done , because it may compromise cardiac flow from the IVC. Closed suction drains are placed inside the abdomen and the patient is transferred to the intensive care unit. Vigorous rewarming is instituted and every attempt is made to treat the coagulopathy in ICU. Is done by adequate blood and fluid transfusion , rapid rewarming of the patient . After correcting hemodynamic instability, acidosis, hypothermia and coagulopathy, the patient may be returned to the operation theatre for pack removal. This is usually done at least 24 hours later and should be within 72 hours.

Surgical clamps:

The various surgical clamps for liver falls into two categories:

1. Occluding, noncrushing clamps and

2. Crushing clamps.

These clamps are large enough to encompass fully the thickest part of the liver, both posteriorly and anteriorly. Successful placement of these clamps, which often requires previous dissection of the ligamentous attachments of the liver, stops the bleeding dramatically. This rapid cessation of bleeding permits further patient resuscitation and definitive treatment of the anatomical injury in a dry surgical field.

Liver suture:

Direct suturing of the liver should not be a first step but it should be an adjunctive procedure. Ideally the liver sutures should have be placed parallel to the liver laceration to control the bleeding by compression of the hepatic substance rather than opposition of the lacerated edges. It is a heavy absorbable suture mounted on a large, curved blunt tipped needle. These sutures are passed deeply into the hepatic substance few centimeters away from the site of injury, passes deeply through the hepatic substance outside of the laceration, and exits on the opposite site, as a figure of eight or as a simple suture. Sutures should be tied lightly enough to oppose the edges of the fracture and to control bleeding . The suture may be tied over bolsters.

Debridement:

At times, hepatic injury is of such severity as to require a major resection of devitalized tissue known as resectional debridement. This usually done in cases of avulsion injury (Grade IV) of liver and will often involve the right lobe of the liver. Major injuries sustained by the lateral segment of the left lobe of the liver (segment II and III) are usually treated by resectional debridement. Various techniques are applied to divide the hepatic substance during the course of a resectional

debridement of liver. These are Finger fracture technique, Cavitron ultrasonic surgical aspirator (CUSA),Laser knife,Water jet knife ,Suction knife, Micro wave tissue coagulation.

Omental packs: Stone and Lamb (1975) have recommended the use of omentum as a living pack for liver injuries. If additional length of omentum is needed, the omentum can be mobilized from the transverse colon from left to right. The lacerated wound is closed with sutures around the omentum.

Juxta hepatic venous injuries; when there is injury to major hepatic veins or the juxta hepaticvenacava (Grade V and VI injuries) the surgeon should decide whether to proceed with definitive treatment or to attempt temporary control of hemorrhage with a pack. Definitive repair usually requires identification of vessels of the liver.

There are three techniques for vascular isolation of the liver.

- Placement of atrial caval shunt through the right atrium of the heart.
- Placement of an intra caval shunt from below the liver and
- Use of multiple occlusive clamps to control bleeding.

Mesh hepatorraphy:

The goal of the prosthetic encapsulation of the liver with mesh is to obtain sufficient compression of the liver parenchyma, and thus to achieve hemostasis. Absorbable mesh should be wrapped around the liver in such a fashion as to compress the liver after freeing the liver of its peritoneal attachments. The use of mesh is best suited for grade III and grade IV and lobar tears.

Drainage:

The purpose of the drainage is to monitor for bile and blood and to establish a tract for drainage of the fragments of devitalized liver tissue. A closed drain system is advocated.

Postoperative course:

When patients undergo major hepatic resection, there may be deficient of coagulation factors, albumin and may go for hypoglycemia. These are replaced by infusion of 10% glucose, coagulation factors and salt free albumin. Nutritional support is very essential in cases of severe liver injury.

POST OPERATIVE COMPLICATIONS:

1. Post operative bleeding/ hemobilia:

Bleeding from the liver in the immediate post operative period may either be from insufficient hemostasis or due to coagulopathy. Coagulopathy may result alone or in combination with multiple transfusions which results in wash out of coagulation factors , transfusion reaction and DIC triggered tissue injury. Documented coagulation defects should be corrected with fresh frozen plasma and platelet transfusions. If coagulation defects are corrected and still hemorrhage persists, bleeding from an unoccluded vessel must be suspected and if the condition of the patient permits, relaparotomy and definitive control of specific bleeding point is the surgery of choice. If the patient is unstable and cannot tolerate a laparotomy, consideration should be given for angiography and selective embolization of the bleeding vessel. Bleeding that occurs once the patient becomes stable is often in the form of hemobilia and is usually a reflection of a pseudo aneurysm. The classical triad in cases of of hemobilia is gastrointestinal bleeding, jaundice and right upper quadrant pain.

2. Intra abdominal abscess:

If fever persists together with a rising white cell count and any other evidence of sepsis, an abscess in or around the liver must be suspected. CT is the preferable method of diagnosing perihepatic abscess. Percutaneous transcatheter drainage has revolutionized the treatment of postoperative perihepatic abscess and resulted in sharply reduced morbidity and mortality. Surgical open drainage of an abscess will be indicated when a safe window for percutaneous drainage is not available, there is sequestrum or percutaneous catheter drainage has failed to resolve the abcess.

3. Hyperpyrexia:

The exact etiology of hyperpyrexia in liver trauma remains unclear but classic teaching is due to devitalized parenchyma being reabsorbed. The hyperpyrexia will resolve in most patients over the first 3-5 days after surgery. Persistent fever beyond this suggests possibility of either pulmonary or intra abdominal sepsis.

4. Biliary fistula:

A persistent biliary leak in the post operative period is because of a missed intrahepatic disruption of a biliary duct. In the absence of any distal biliary obstruction, most of the biliary fistulas close within 6 weeks.

NON OPERATIVE APPROACH:

Conservative management of stable patients with hepatic injuries diagnosed on CT is now practiced in many hospitals. CT based criteria for non operative management are:

1. Simple hepatic parenchymal laceration or hematoma. Grade I to II injury (CT evaluation).
2. No evidence of any active bleeding.
3. Intra peritoneal blood loss of less than 250ml.
4. Absence of any other intra peritoneal injuries requiring surgery.
5. Easy access to CT scan and operation theater.
6. Availability of surgeon / radiologist with good experience in interpreting the CT Scans and in emergency lapratomy .

If the patient is planned for nonoperative approach then patient is placed on strict bed rest and repeated physical examination is done by the same surgeon. Complete blood count and hematocrit is done 12th hourly. Ultrasound is done daily. Depending upon the second ultrasound findings, the patient is planned for conservative or operative management. If non operative management is chosen, the patient have to

be advised bed rest for a period of 5-7 days and then discharged to home for further bed rest for 4 weeks. After 4 weeks repeat CT is done and by this time 95% of lesion would have healed. Individual is then permitted to return to his normal work. Active sports should be avoided for 3 months.

Biliary tract trauma:

The treatment of biliary tract injuries is complicated by associated injury to the pancreas or duodenum. The most common location for CBD disruption is at the point of transition between the flexible part of the common bile duct, with in the hepatoduodenal ligament and the fixed portion of the duct within the pancreas. If there is a central zone injury to the liver and a major intra hepatic bile duct injury is suspected, an intra operative cholangiogram can be used for diagnosis. Injury to the pancreatic head can be assessed by preoperative or intra operative ERCP or cholangiography, which may reveal a distal CBD injury.

Treatment:

Cholecystectomy is done for injury to the gall bladder. An incomplete transection of an extra hepatic bile duct in an accessible location is best treated by T tube insertion through a separate choledochotomy and repair of duct over the T tube . A complete

transection of bile duct, if both ends are accessible can be repaired by direct anastamosis over a T tube.

If case of extensive damage to the ductal system is choledochoenteric anastomosis will be necessary .If the duct is completley damaged and if the patient's condition does not allow for a reconstructive procedure, a catheter can be inserted into the proximal duct and an external fistula can be created. In case of isolated intra pancreatic injury of the bile duct with complete division, the treatment of choice is ligation of the distal duct and reimplantation of the proximal duct into a Roux-en Y loop of jejunum.

Injury of the hepatic artery and portal vein:

Injuries to the hepatic artery and portal vein should be repaired. The liver can survive with either hepatic arterial flow or portal venous flow. If ligation of hepatic artery is proximal to the cystic artery, the gall bladder should be removed to prevent gangrenous cholecystitis. If irreparably damaged, ligation of portal vein is preferable to a portocaval shunt . If both the portal vein and the hepatic artery are damaged beyond the possibility of primary repair, flow must be established through one of the vessels by a venous graft as an interposition or a conduit from another source.

SPLEEN :

It is the most common visceral organ to rupture following blunt abdominal trauma. Factors which contribute to its increased susceptibility to injury in trauma are its soft consistency , intimate proximity with ninth to twelfth ribs ,its tendency to enlarge and becoming pulpier with variety of disease.

PATHOLOGY:

It can be either be an avulsion from the pedicles, multiple fissure fractures of spleen, an enlarged spleen splitting on its outer aspect to produce either a tear or subcapsular hematoma . Less common finding is a small tear in the anterior aspect of hilum, which may produce severe bleeding but it is difficult to isolate the bleed.

Table 3: Splenic injury scale:

GRADE	INJURY DESCRIPTION
I	Hematoma: Subscapular, non-expanding<10% of the surface area. Laceration: Capsular tear, non bleeding, <1cm of parenchymal depth
II	Hematoma: Subcapsular, non-expanding, 10-50% of the surface area, intraparencymal, non-expanding, <2cm in diameter. Laceration: capsular tear with active bleeding.
III	Hematoma: Subcapsular, >50%of the surface area or expanding ruptured.Subcapsular hematoma, active Bleeding. Intraparenchy mal hematoma>2cm or Expanding. Laceration: >3cm parenchymal depth or involving trabecular vessels.
IV	Hematoma: ruptured intraparenchymal hematoma with active bleeding. Laceration: involving segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Completely shattered spleen. Hilar vascular injury that completely devascularises the spleen.

Clinical presentation:

The different scenarios, a patient with splenic injury can present are:

1. Rapid death:

The spleen will be completely avulsed or severely mangled by blunt abdominal trauma. The patient dies before starting resuscitation or a laparotomy could be performed.

2. Shock:

This is due to splenic rupture. This is the most common group. Trauma to the lower thorax or abdomen is followed either by an absence of symptom for few hours or vague distress. Then suddenly within a matter of few minutes symptoms are exaggerated. There is abdominal rigidity and the patient shows signs of hypovolemia and there is evidence that points to serious intra abdominal pathology. The patient will become pale. Abdomen will be distended. Tenderness is commonly seen in the left upper quadrant and frequently pain is accentuated by deep breathing. In early cases, pulse may not rise above 90 and blood pressure is often unaltered for several hours. Referred pain to the left shoulder is a valuable symptom.

Delayed rupture:

When the trauma and acute events, which lead to surgery, are separated by days and some times months. The diagnosis can be made by four general methods.

History of injury in the recent past with general signs of blood loss associated with local signs like bruising, tenderness, rigidity, fractured ribs and positive Balance's sign , Kehr's sign positive and presence of palpable tender spleen.

Signs of splenic injury are:

1. Balance's sign: Fixed dullness in the left flank and right flank. Change of dullness on change of position.
2. Seagesser's sign: Pain produced in the neck by pressure over the phrenic nerve over the left supra clavicular region.
3. Hardi sign: sternal saggital compression produces sharp pain below the left costal margin in splenic rupture.
4. Snow ball sign: Bulge in the pouch of Douglas due to hemoperitoneum.

Ultrasound (FAST) has been used successfully in the diagnosis of splenic injury and remains useful adjuncts in the absence of CT. Ultrasound has its own technical draw backs, including image limitation by dressings, tubes, wounds, gastrointestinal ileus, and problems with positioning of a severely injured patient. Radioisotope scanning is useful in diagnosis in about 90% of cases.

Advantage of scintigraphy over CT includes its feasibility in the moving, uncooperative patient and a lower risk of contrast reaction. Angiography has been used to demonstrate splenic injury, as well as to document persistent arterial bleeding.

Contrast enhanced CT detects splenic trauma with a high degree of accuracy. Its major advantage is a relatively specific delineation of the degree of organ injury. DPL is easy, rapid, accurate and is used in hemodynamically unstable patients or in patients with associated injuries requiring immediate treatment.

Management:

Preoperative considerations:

Proper management of patients with blunt injury spleen begins with resuscitative measures with rapid infusion of 1 to 2 liters of ringer lactate solution.A naso gastricor an orogastric tube should be positioned

to decompress the stomach., blood should be sent for blood typing and cross matching and blood transfusion to be started immediately possible. Once in the operating room auto transfusion systems are available for recovery and reinfusion of blood vessels.

Operative management:

The patient is positioned supine on the operating table and may be rotated 15 degrees toward the operating surgeon (standing on right side) so that there is greater exposure of the left upper quadrant. A midline incision, with adequate extension to the xiphoid process, is preferably used to facilitate exposure and treat associated injuries. Complete mobilization of spleen is the key to adequate assessment of injury and safe repair. Any blood should be evacuated from the area in order to optimize visual and palpatory examination.

If splenic injury is apparent, spleen is mobilized form its surrounding ligaments, the lienorenal and phrenicolic ligaments , which are avascular and can be sharply incised away from the lateral margin of the spleen. The vessels in the lienocolic ligament may need to be ligated and divided. Persistent massive bleeding from spleen usually can be controlled by manual compression of the spleen .If this is not successful temporary control of the splenic artery at the superior pancreatic margin

by grasping the splenic pedicle with thumb and fore finger is helpful when there is persistent active bleeding. Splenectomy is done in patients who remain in shock after control of the splenic pedicle, and in patients who have other potentially life threatening problems, such as severe head trauma or thoracic trauma with poor gas exchange or widened mediastinum. Because attempts at splenorrhaphy can prolong the operation, splenectomy is strongly considered in patients with medical contraindications to prolonged surgery, such as coagulopathy, hypothermia and cardiac, pulmonary or hepatic disease.

Grade I injuries:

These require little or no treatment. Tamponade with a dry sponge for 5 minutes or topical hemostatic agent applied to the injury site is quite sufficient.

Grade II injuries:

These can be treated with hemostatic agents (including microfibrillar collagen, gelfoam soaked in topical thrombin, or surgicel) with tamponade to control bleeding. Continued bleeding from grade II injuries is treated by direct suture of the spleen (splenorrhaphy). The firm parenchyma is approximated using monofilament such as chromic catgut

or polypropylene on a large needle. Mattress sutures are placed over a buttress of omentum,

Grade III injuries:

The principles involved in treating these injuries are:

a. Removal of clot and devitalized tissue, complete reapproximation of parenchymal edges to the depth of the wound to avoid leaving dead space, and suture placement within the fibrous splenic capsule well away from the wound margin to prevent tearing.

b. Expanding hematomas should be opened, the clot evacuated and a diligent search made for parenchyma arterial bleeding, which can be controlled with suture ligature.

c. Another technique is to use polyglycolic acid mesh wrapping it around the spleen to partially approximate sections after local hemostasis has been performed with sutures.

Grade IV injuries:

These often require partial splenectomy for segmental devascularization. Hemostasis in the hilum is attained by selective ligation of the appropriate segmental artery. Debridement is

accomplished by finger fracture or sharp resection at the line of demarcation. As described in grade II injuries, wrapping of absorbable mesh can also be used to tamponade. Splenectomy should be done if, after a reasonable attempt, splenorrhaphy is unsuccessful.

Grade V injuries:

Splenectomy is advised for grade V injuries. It is now used in 40-60% of splenic injuries. In modern trauma centers, it is particularly advised when patient is in hypotension and with multiple associated intra abdominal injuries.

Post operative complications:

Atelectasis, pneumonia (especially left lower lobe), and left pleural effusion are the most common complications of splenectomy.

Left sub phrenic abscess or effusion: incidence ranges from 3 to 13%, claimed to have higher incidence when left upper quadrant is drained, when associated with intestinal injuries. Resolves slowly but spontaneous drainage should be undertaken if signs do not resolve.

Thrombocytosis: Platelet count of more than 400000 platelets / ccm occurs within 2 to 10 days after splenectomy in as many as 50% of patients. Thrombocytosis usually resolves within 2 to 12 weeks.

OPSI (overwhelming post splenectomy infections): it is defined as a fulminant bacterial illness that progress to death within 24 hours of recognition and does not always exhibit the usual prodromal infection. It is characterized by early systemic symptoms of nausea, vomiting and malaise that rapidly progress to coma, hypotension and death within hours of onset. The organisms most frequently responsible are encapsulated (streptococcus pneumiae, Hemophilusinfluenza and Neisseria meningitides), but Escherichia coli and other coliforms have been cultured from patients with this syndrome. Hence all patients should be given polyvalent pneumococcal vaccine following

Non operative management of splenic injuries:

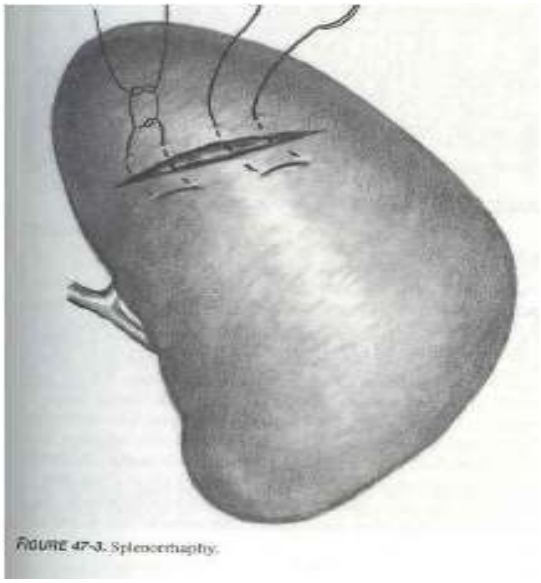
Non operative management of splenic injuries in children has become common and is successful in over 90% of cases in which it has been attempted (grades 1-3) because of the hemostatic properties of the splenic capsules. Non operative management of splenic trauma has also been adopted for adults. The following are the criteria for selecting candidates for non-operative management of splenic injury.

d. Blunt trauma – no history of hemodynamic instability.

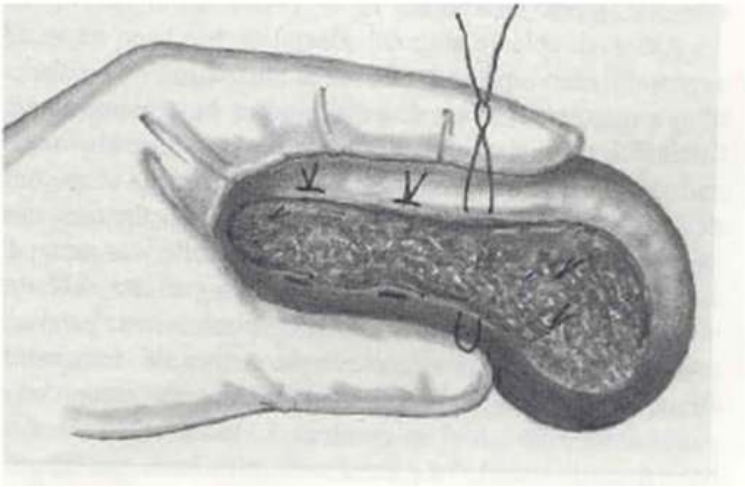
e. An isolated splenic injury (grades 1-2)

f. Alert patients (no head injury or intoxication)

Fig 3: Splenorraphy



Placement of mattress sutures during partial resection



Pancreas:

The incidence of pancreatic injury in severe abdominal trauma is about 3-12% with blunt trauma contributing about 1/3 of these patients. The spectrum of pancreatic injuries are broad, ranging from simple contusion to fracture/ laceration to complete disruption. The proximity of the pancreas to other vital structures and the high energy mechanisms typically involved make isolated pancreatic injuries uncommon. Injuries to the head of the pancreas are commonly associated with blunt injuries to the liver, duodenum and major vascular structures. Injuries to the body are associated with blunt trauma to transverse colon. Injuries to the tail of the pancreas are associated with injuries to the spleen.

Mechanism of injury: Blunt pancreatic injuries occur when high energy crushing force is applied to the upper abdomen. The energy of impact is usually directed at the epigastrium or hypochondrium, resulting in a crushing of the retroperitoneal structures. Epigastric pain out of proportion to the abdominal examination is often a clue to a retroperitoneal injury.

Following is the commonly used method of classification of pancreatic injuries.

Classification of pancreatic injuries:

TYPE	DEFINITION
I	Contusion and laceration without duct injury
II	Distal transection or parenchymal injury with duct injury
III	Proximal transection or parenchymal injury with probable duct injury .
IV	Combined pancreatic and duodenal injury ,Ampulla and blood supply intact
V	Massive injury, ampulla destroyed, devascularisation[2].

Diagnosis:

Most patients with injuries to the retroperitoneal pancreas will have minimal clinical symptoms and signs when seen first after trauma. Thus symptoms may be absent for 12 hours. Severe epigastric pain out of proportion to the clinical features may indicate pancreatic injury.

Serum amylase: Though not specific, serum amylase (isoenzyme) levels should be followed in a patient in whom there is a suspicion of a pancreatic injury or in whom the first amylase drawn in the emergency room has been elevated. A progressive rise in the amylase over the first

24 hours of hospitalization is strongly suggestive of injury at either the pancreas or the duodenum.

Computed tomography : May provide direct information about the location of pancreatic injuries as well as providing 3 dimensional picture of the wound. However pancreatic injuries may be missed.

Diagnostic peritoneal lavage : will show negative results since pancreas is retroperitoneal.

Laparotomy:

The single most reliable means of making the diagnosis of pancreatic injuries.

Management:

General principles involved in the management of pancreatic injuries are:

1. Control hemorrhage and contain bacterial contamination.
2. Debride and devatilized pancreatic tissue.
3. Preserve at least 20-50% of functional pancreatic tissue whenever possible.
4. Provide adequate internal or external drainage of pancreatic injuries or resections.

Type 1: Contusions and lacerations without duct injury:

These require only hemostasis and simple external drainage. Attempt to close or repair capsular laceration may result in pancreatic pseudocyst, whereas a controlled pancreatic fistula is usually self limiting. Between 2-15% of the patients with grade I injuries will develop a pancreatic fistula, but most are low output (<500ml/day) minimally affected by oral intake and mostly close spontaneously within 2 weeks .[6]

Type II and III injuries:

Distal parenchymal transection or injury with duct disruption is best treated by distal pancreatic resection with or without splenectomy. Splenectomy makes distal pancreatectomy easier and more rapid because the splenic artery and vein as well as distal tip of the pancreas need not be dissected. The remaining proximal duct should be closed with a direct suture ligature either as U stitch or a figure of 8 with non absorbable suture. The parenchyma is controlled with mattress sutures placed through the full thickness of the pancreatic gland from anterior to posterior capsule to minimize leak from the transacted parenchyma. A small omental patch can be used to buttress the surface and a drain should be left near the transection line. Distal pancreatic resections are classified as extended, major or limited. Approximately 80% of the pancreas have

to be resected before a patient is at risk of endocrine insufficiency and diabetes.

TYPE IV and V INJURIES: Are defined as a ductal disruption to the right of the superior mesenteric vessels.

Injuries to the head or neck, which do not involve the pancreatic duct, are simply drained. Severe damage to the head of the pancreas, even in the absence of duodenum injury is particularly serious. Hemorrhage from the portal vein, vena cava, aorta or mesenteric vessel will often result in exsanguinations during or shortly after surgical attempts at control of the injuries. Presuming that such injuries either are not present or are adequately controlled, there are several options to deal with grade IV and V injuries but the treatment has to be tailored to the individual patient.

1. Extended pancreatectomy involving 80-90% of the gland will result in insufficiency. In order to avoid this after transecting the pancreas at the level ofinjury, closing the proximal pancreatic resection, an internal drainage from the distal fragment is accomplished by Roux-en-Y distal pancreatojejunostomy by end to end to side method.

2. Onlay Roux-en-Y: Major injuries to the pancreatic head without ductal damage is best treated conservatively by stump drainage. If the duct is damaged an on lay Roux-en-Y loop is probably the best procedure.

3. Duodenal diversion: These are more suited when the duodenal injuries are complex with pancreatic head injury. There are two ways of achieving this:

   a)Pyloric exclusion: After repair of duodenal tear, a 4 cm gastrostomy is made along the distal greater curve. Through this the pylorus is approached and a polyglactin or chromic catgut suture is inserted to closethe pylorus. A gastrojejunostomy is then constructed suing the same gastrostomy.

b)Duodenal diverticulization: this is a more extensive procedure requiring duodenal repair, vagotomy, antrectomy, gastrojejunostomy, pancreatic resection, T tube drainage of CBD and tube duodenostomy.

4) Pancreaticoduodenectomy: This carries an unacceptably high mortality rate in the acute situation. The overall mortality rate is 30-40%. A Whipple's procedure should therefore be performed only on the most severe injuries where the trauma has effectively performed the resection

and the operation is essentially debridement of devitalized tissue. The incidence of such procedure is no more than 2%.

Complication:

Fistula: This is the most common complication arising after pancreatic trauma. The incidence is 7-20% rising to 26% after combined pancreaticoduodenal injury. Fistula may drain 1000ml/day depending on size. Supplemental replacement of potassium bicarbonate and in prolonged cases zinc and magnesium may be necessary. Recently a somatostatin analogue, octreotide has been used. T

Abscess: Incidence is 10-25%, usually develop as a result of associated injuries to the adjacent viscera. They all require percutaneous drainage or re laprotomy

Pancreatitis: The development of pancreatitis after pancreatic trauma is a common and serious complication and may carry a high risk of death. The treatment is the same as for any patient with pancreatitis. Other complications such as pseudocyst, postoperativehemorrhage, wound sepsis and exocrine and endocrine insufficiency needs to be managed appropriately.

Death: Mortality rate varies from 3-32% and depends on type of injury, presence and type of associated injury and the cause of injury.

Kidney and Suprarenal:

The most common symptom in patients with traumatic genitourinary tract injury is hematuria. The degree of hematuria does not always correlate with the severity of urinary tract Injury. Radiographic evaluation has to be done in all trauma patients who comes with hematuria. However, the majority of renal injuries are minor and can be treated conservatively.

Thus radiological investigations are restricted to the patients who are likely to have significant renal injuries or gross hematuria or patients in shock . An area of poorly opacified renal parenchyma signifies renal contusion. Renal laceration will extends to the surface of the kidney, so a subcapsular or perinephric hematoma will also be present in patients with renal laceration . If the renal architecture is flattened by the compressive force of a hematoma contained by an intact renal capsule, a subcapsular hematoma can be diagnosed. A perinephric hematoma is formed when clot runs away from the kidney in case of capsular injury . On injection of iv contrast the infarcted portion of kidney does not enhance . However, if the capsular vessels of the kidney remains intact a

thin rim of enhancing parenchyma may be detected . The kidney is unaffected when there is good collateral flow . If there is poor collateral flow, the affected kidney becomes edematous, swollen, and the function of kidney will deteriorate. Ureteropelvic junction avulsion is readily diagnosed on CT by the extravasation of the excreted contrast material.

Adrenal gland

The adrenal glands are injured less frequently in blunt trauma. The adrenal glands lie near the middle of the upper abdomen and are well protected by the ribs , spine, and major abdominal organs. An adrenal hematoma is visualised as a round to ovoid adrenal mass. Strands of high density material which indicate the hemorrhage may be seen in the perinephric fat. Initially the hematoma of adrenal gland may demonstrate an hyperdensity. Over a period of time the density decreases as the clot starts to lyse. This is the most common etiology for adrenal pseudocysts. The amount of blood loss in adrenal injury is very less and more than 90% of functioning adrenal tissue must be lost before the patient becomes adrenal insufficient. However, in cases of bilateral adrenal hematomas , the potential for developing Addison's disease must be considered.

Pathophysiology:

As the kidney gets squeezed or crushed, there is varying degree of compression on the kidney tissue, causing pathological lesions. These may be classified into two broad types:

I. Minor injuries: (85%)

1. Contusion: There is bruising of renal tissue and macro or microscopic hematuria; no gross parenchymal damage.

2. Laceration: when there are radial lacerations across the kidney, up to the surface or up to the calyces, but no fragmentation.

II. Major injuries: (15%)

1. Rupture: when lacerations are through and through- thus causing fragmentation of the kidney.

2. Shattered kidney: when there are multiple fragments of the kidney, many of themdevascularized.

3. Pedicle injury: Injury to the major blood vessels of the renal pedicle, with or without parenchymal injury.

Effects of injury can be:

Hemorrhage: This is caused by rupture or pedicle injury , due to the tight gerota'sfascia, there is a tendency to limit the size of expansion of the hematoma. Eventually hematoma may undergo encapsulation and fibrosis.

Urinary leakage: whenever there is a rupture of kidney, urine may escape outside the renal capsule and form either diffuse extravasation or a localized collection called Urinoma. If renal function is satisfactory, rupture is large or there is distal block then the urinoma keeps expanding.

Ischemic necrosis: In pedicle injury, whole kidney may be ischemic; in rupture or shattered kidney, one or multiple segments may have blood supply compromised. Expanding hematoma also tends to jeopardize blood supply to the small fragments.

Diagnosis:

History of trauma to the loin would be present inevitably in case of blunt trauma to the abdomen or to the flank and exclusion of urinary tract injuries is essential in those cases . Loin pain is significant finding in nearly all cases. Hematuria is the common presenting symptom, though in

minor contusion, this may be microscopical. Sometimes, due to intra-pelvic clotting, severe injury may have relatively small hematuria. Absence of hematuria does not exclude renal injury.

Onset of loin pain, fullness over renal area, increasing abdominal girth, ileus, ecchymosis over flanks due to associated intra abdominal injury or hematuria and unexplained hemodynamic instability or fracture of 10th,11th,12thribs following blunt abdominal trauma need to be investigated.

Investigations are done with two main purposes. Firstly, to evaluate and to stage the injury, and secondly, to see for the presence of functional status of kidney.

Investigation :

1. Urinalysis: There will always be hematuria; in multiple organ trauma. e.g. in road traffic accident, often microscopic. Hematuria is the only pointer to renal injury especially contusion.

2. Intravenous urography: This is an essential investigation, that must be done in all cases suspected to have renal injury and should be done as early as possible.

3. IVU will show:

a) Presence and function of the contralateral kidney.

b) Nature and degree of laceration.

c) Extravasation of the dye- in rupture and

d) Non functioning kidney in case of pedicle injury.

4. Ultrasonogram: Is of value in detecting pre-existing or developing hydronephrosis, urinoma and para-renal pseudo hydronephrosis. It is indicated early in cases of non functioning kidney (on IVU) to detect parenchymatous state and site of hematoma- intra renal or pre-renal.

5. Selective renal angiography: In centers well equipped to perform emergency angiography,this investigation carried out early may diagnose cases of pedicle injury, where vascular reconstruction and renal salvage may be possible.

6. Radionuclide imaging: May also help in identifying ischemic fragments or infracted kidney.

7. Retrograde pylography: This is indicated only if patient is allergic to iodine, or when there is doubt even following angiography, whether one is dealing with renal agensis or pedicle injury.

8. Computed tomography scan: It is preferred modality of investigation for blunt injury. It provides better information of lacerations if present and blood collection within gerota's fascia. Other organs of abdomen are also defined simultaneously. Small areas of infarct(1cm) are easily detected on CT scan. In contrast enhanced CT, renal infarcts are classically described as cortical rim sign.

Management:

The pendulum of conception of ideal management of renal injury veers from early surgery (except in contusion) to ultra conservatism, where only pedicle injury is considered indication for surgery. Pathologically considering, minor injuries do not need surgery while major injuries may need surgery either immediately or subsequently. For blunt injury, the problem of early surgery is that on opening the gerota's fascia, often there is massive hemorrhage that necessitates nephrectomy. Hence whenever early surgery is indicated, anterior transperitoneal approach and preliminary control of vascular pedicle is mandatory,before opening the gerota's fascia. [2,6.] Renal contusions and lacerations (type I and II) make up 85% of blunt injuries and are to be treated conservatively. The remaining 15%, which contribute to major (type III

and IV) renal injuries need surgical intervention. Vascular injuries make 2-5% of renal injuries and need immediate resuscitation and exploration in view of the deteriorating condition and hypovolemic shock . It consists of bed rest, sedation, treatment of shock by blood transfusion, nasogastric suction (for paralytic ileus), serial excretory urogram and constant observation. Objective of treatment is to allow absorption of hematoma without infection; antibiotics should be given for 7-14 days.

Surgical technique: As applied to early or interventional surgery.

1. Approach: anterior trans peritoneal, either vertical (paramedian) or transverse incision.
2. Initial dissection of renal arteries: Bulldog clamp applied to renal artery and then vein. Only then the gerota's fascia is opened by making a paracolic incision.
3. Actual operative procedure will depend on pathological lesion found. Basically the objective is renal salvage. Principles of repair would constitute the following essentials:
    i. Debridement of all devitalized renal parenchyma,
    ii. Meticulous hemostasis,
    iii. Water tight closure of the collecting system,
    iv. Approximation of margins and obliteration of the dead space,

For rupture: If it is small polar segment, with blood supply doubtful, partial nephrectomy is best. In others, careful calycorrhaphy, cortical hemostasis and nephrorrha phyoromentum grafting is done.. Shattered kidney: If explored, needs nephrectomy. Nephrectomy is done by ligating and dividing the renal artery and vein individually and ureter as low as possible.

Pedicle injury: If operated very early, reconstruction is possible. But in most of the cases nephrectomy is done.4. Local toilet is a must in all cases and a drain must be provided.

Complications:

1. Secondary hemorrhage
2. Late hypertension
3. Pseudocyst and Urinoma are common but pose dangerous complication

MATERIALS AND METHODS

Study design :

Observational study.

Setting:

Patients were selected from inpatients in trauma ward , CMCH, Coimbatore.

Study period:

12 MONTHS (august 2013 to august 2014)

Inclusion criteria:

Patients admitted with blunt abdominal trauma with solid organ injury in cmch.

Age > 18 yrs

Exclusion criteria:

Patients admitted with penetrating abdominal injury.

Patients admitted with hollow viscus injury

Methods of collection of data:

After admission of the patient , data for my study was collected by:

1. Direct interview with the patient or patient relatives accompanying the patient and obtaining a detailed clinicalhistory.
2. Thorough clinical examination.
3. Clinical findings and relevant diagnostic investigations performed over the patient.

After initial resuscitation of the patients, thorough assessments for injuries were carried out in all the patients. Documentation of patients, which included, identification, history, clinical findings, diagnostic test, operative findings, operative procedures, complications during the stay in the hospital and during subsequent follow-up period, were all recorded on a Proforma specially prepared. Demographic data collected included the age, sex, occupation and nature and time of accident leading to the injury. decision was taken for further investigations such as CBC,four – quadrant aspiration , x ray abdomen and chest , FAST , CT abdomen.

The decision for operative or non operative management depended on the outcome of the clinical examination, hemodynamic stability and CECT abdomen. Patients selected for non operative or conservative management were placed on strict bed rest, were subjected to serial clinical examination which included hourly pulse rate, blood pressure, respiratory rate and repeated examination of abdomen and other systems. Appropriate diagnostic tests especially ultrasound of abdomen was repeated as and when required.CT scan was done in selected patients in our study. FAST was done in all patients. In general following cases are taken up for surgery.

1) Those with evidence of significant hemoperitoneum
2) Those showing free air under diaphram ,
3) Those patients with signs of peritonitis
4) Patients not responding to conservative management and those deteriorating despite adequate ,

Resuscitation and Treatment

Following definitive management patients are monitored closely for signs of recovery . Undue complications, if any, are managed accordingly. All associated injuries are evaluated and treated accordingly. Any mortality is recorded and cause of it is analysed.

Follow up: Patients are discharged when they are fit and advised to come for follow up after 15 days, 1 month, 3 months and once in 3 months thereafter.

DATA COLLECTION:

All the above details of every patient is recorded in a specific proforma designed for the study and finally inferences are drawn regarding the causes , age and sex distribution , pattern of organ involvement , management , complications , morbity and mortality.

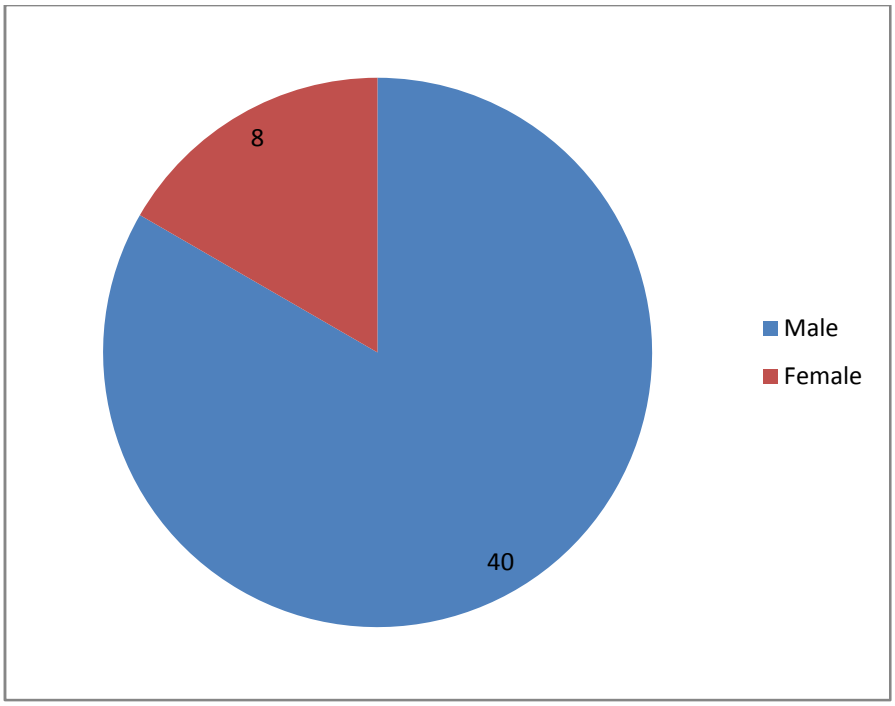
RESULTS

From august 2013 to august 2014, 48 number of cases were studied which belonged to surgical units in CMCH.

Sex incidence

Gender	No of patients	Percentage
Male	40	83.3%
Female	8	16.6%

In 48 cases ,40 were males accounting 83.3% of study population and 8 were females.

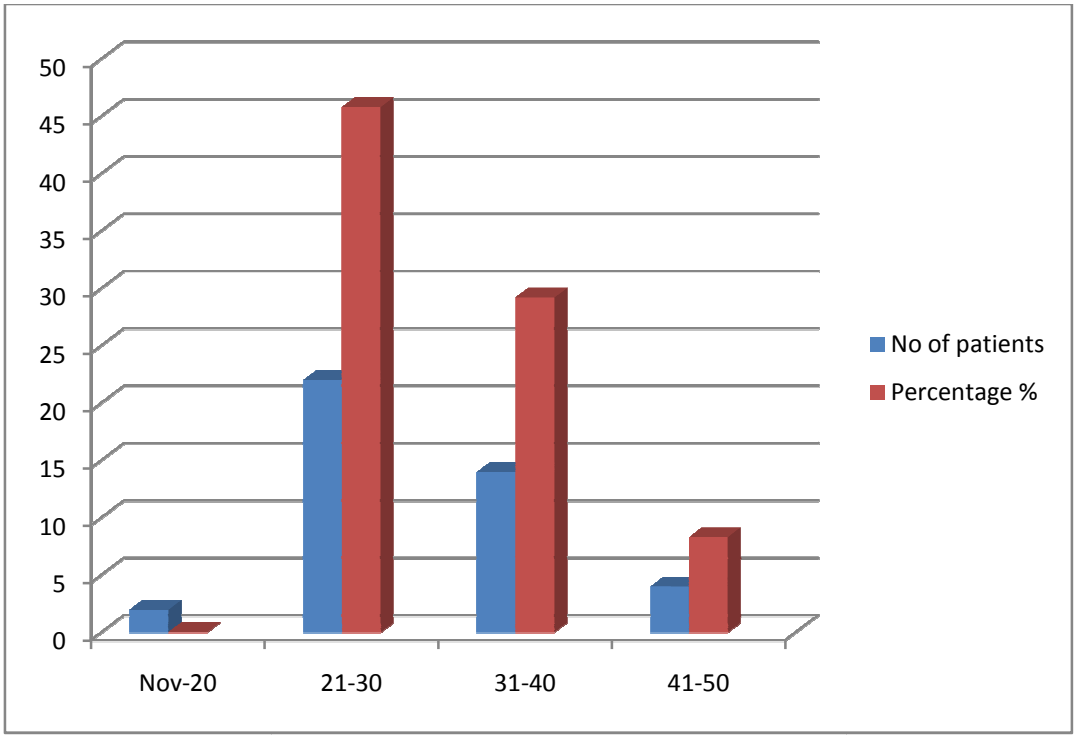


Graphical representation of sex incidence

Age incidence

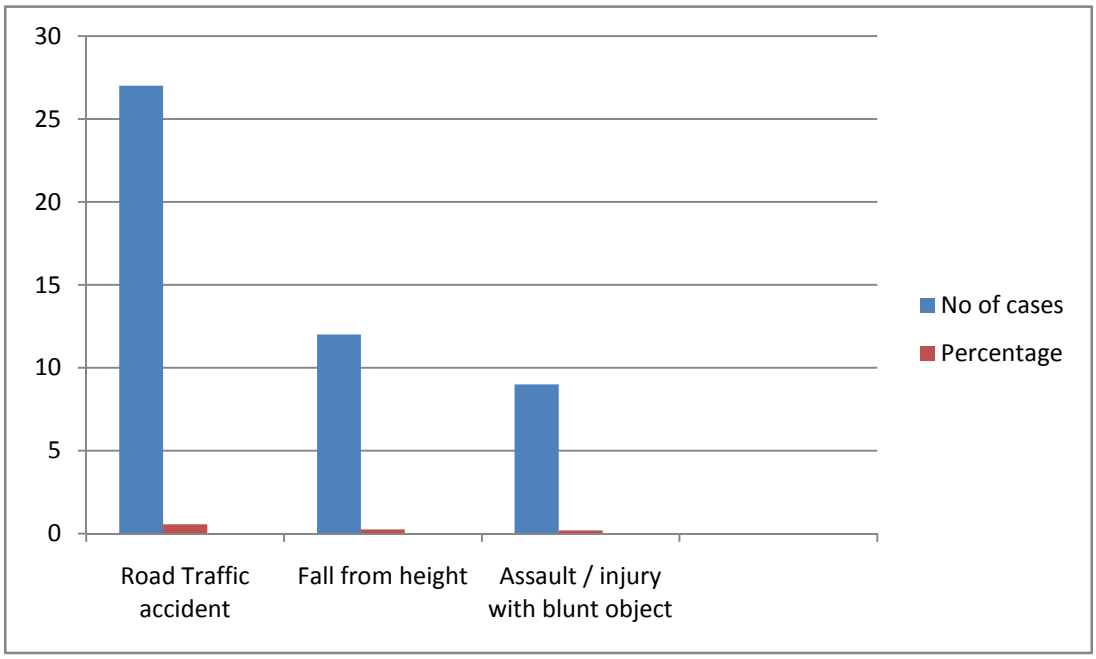
Age Group	No of patients	Percentage
11-20	2	4.1%
21-30	22	45.8
31-40	14	29.2
41-50	4	8.3
51-60	4	8.3
61-70	1	2.1
71-80	1	2.1

In this study majority belongs to the age of 21 to 30 years of age accounting for 45.8% followed by 31-40 years of age.



Mode of injury

Cases	No of patients	Percentage
Road Traffic accident	27	56.2%
Fall from height	12	25%
Assault/injury with blunt object	9	18.8%



Graph showing mode of injury

In 56.2% cases road traffic accident was the mode of injury followed by fall from height in 25%.Least was injury with blunt object in 18.8%.

Clinical presentation

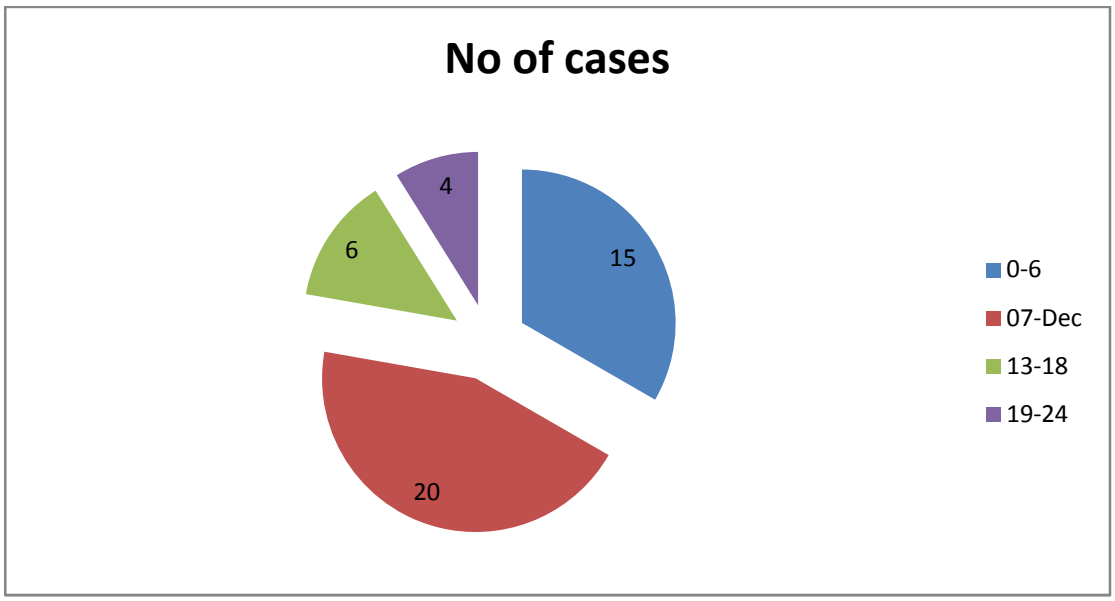
Presentation	No of patients	Percentage
Abdominal pain	43	90%
Abdominal distention	27	56.2%
Hematuria	7	14.6%
Abdominal guarding+rigidity	19	39.6%
Shock	12	25%

LATENT PERIOD:

It is the time interval between time of injury to time of presentation to our hospital.

Latent period

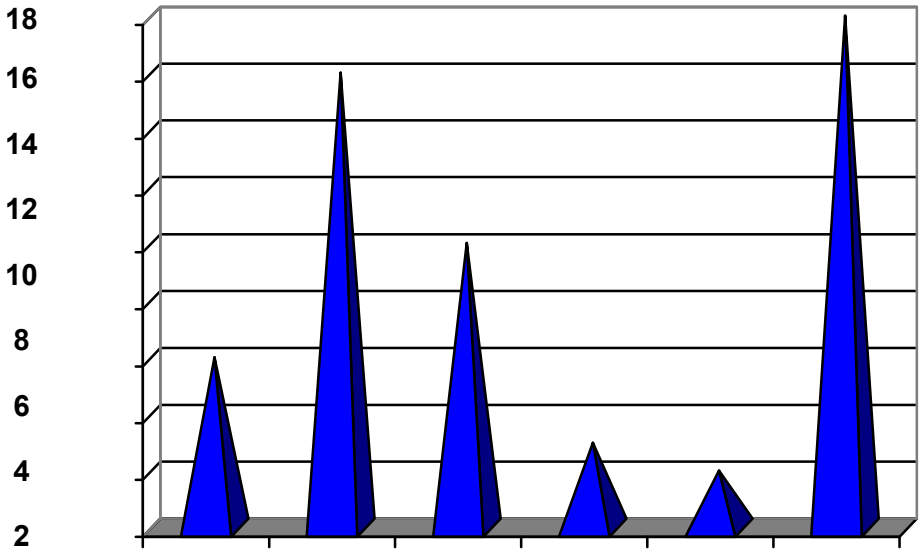
Latent	No of patients	Percentage
0-6	15	31.2%
7-12	20	41.7%
13-18	6	12.5%
19-24	4	8.3%
>24	1	2.1%
Not known	1	2.1%



Graph showing latent period

Associated injury

Associated Injury	No of patients	Percentage
Head	6	12.5%
Thorax	16	33.3%
Extremities	10	20.8%
Pelvis	3	6.2%
Soft tissue injury	2	4.1%
No association	18	37.5%



Graph showing associated injury

Associated injury along with abdominal injury was present in 30 cases.The common extra abdominal injury was thoracic in the form of fractured ribs and hemothorax followed by extremities fracture, head injury ,pelvis and soft tissue injury.

HEMOGLOBIN:

Hemoglobin%

Hb %	No of Cases	Percentage
≥10gm%	19	39.6%
8-10gm%	18	37.5%
<8gm%	11	22.9 %

Hemoglobin was above 10gm% in 39.6% of patients and was <8gm% in 22.9%cases.

Hematocrit value: Hematocrit was done in 45 patients and was not done in 3cases

Hematocrit%

Cases	No of patients	Percentage
<30%	20	44.4%
30-45%	9	20%
>45%	16	35.5%
Notdone	3	6%

URINE MICROSCOPY:

Urine microscopy showed RBCs in 17% cases whereas 83% cases it was normal.

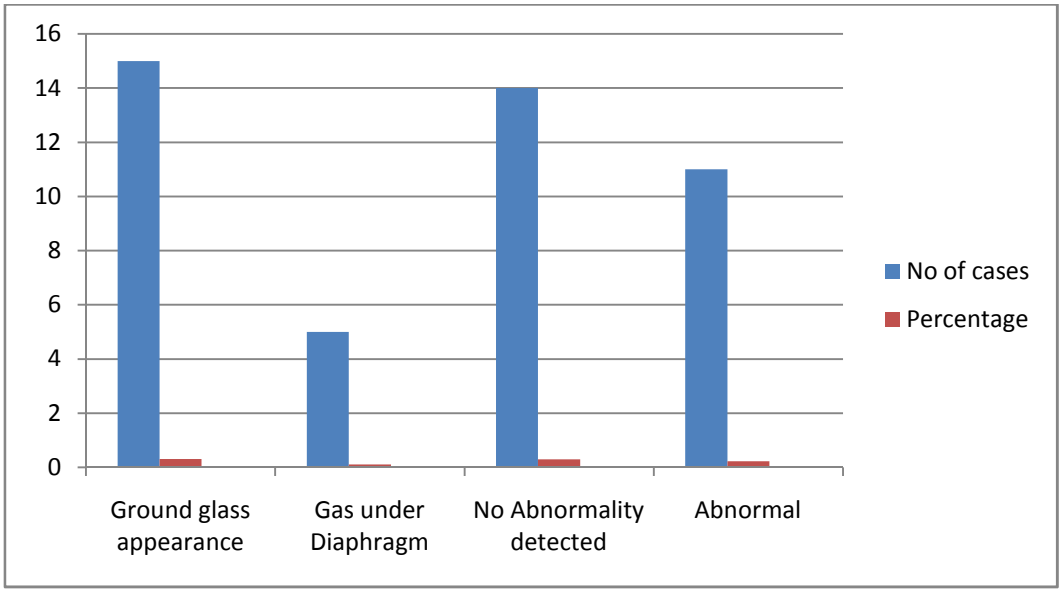
Urine microscopy :

Microscopyopy	No of patients	Percentage
Normal	40	83.3%
Macro Hematuria	05	10.4%
Micro Hematuria	03	6.25%

X-ray ERECT ABDOMEN

X ray erect abdomen

Xray Erectabdomen	No of Cases	Percentage
Ground glass appearance	15	31.25%
Gas under Diaphragm	5	10.41%
No Abnormality detected	14	29.16%
Abnormal	11	22.91%
Not done	3	6.25%



Graph showing Xray erect abdomen results.

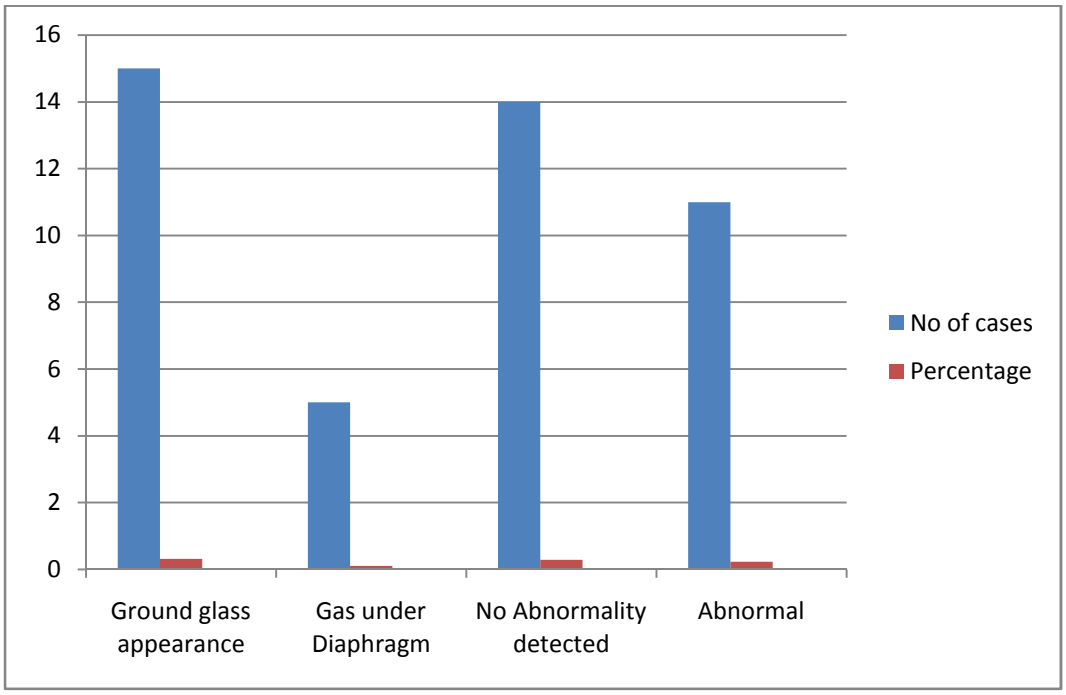
Plain Xray erect abdomen was done in 45 cases not done in 3 cases as they were hemodynamially unstable .29% of Xray erect abdomen was normal in our series.

FOUR QUADRANT ASPIRATION:

Four Quadrant Aspiration was done in 31 cases. It was positive in 23cases.

Four quadrant aspiration

FQA	No of Cases	Percentage
Positive	23	47.91%
Negative	8	16.7%
Notdone	17	35.41%



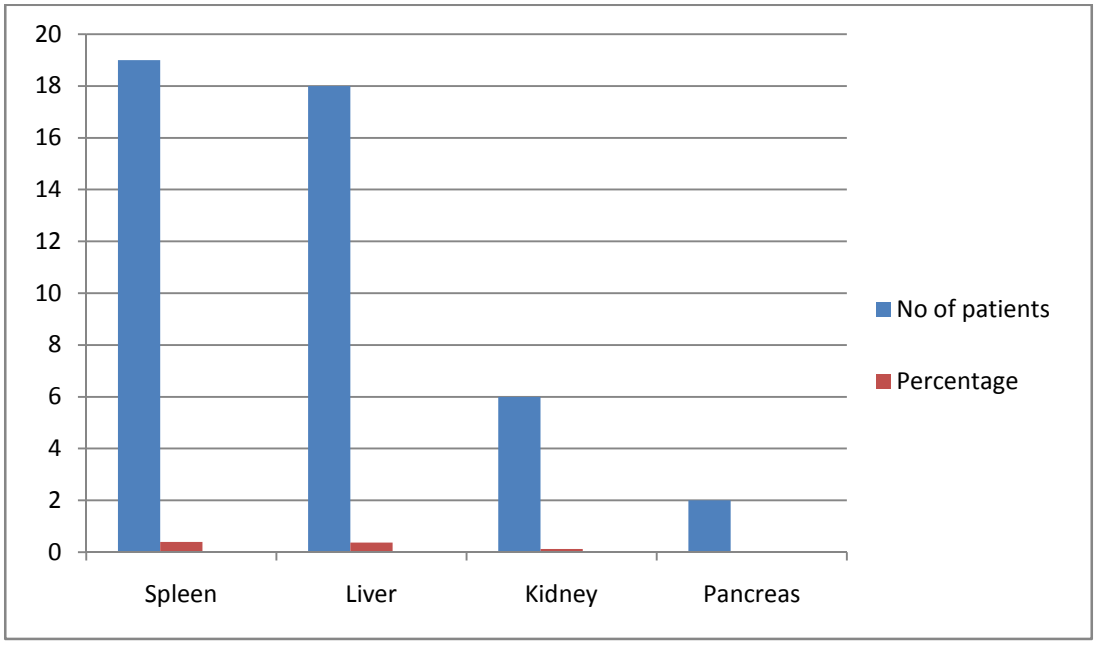
Graph showing four quadrant aspiration results

ULTRASONOGRAPHY OF ABDOMEN:

USG abdomen was done in all 48cases.Organ injury in USG abdomen:

USG abdomen

Organ	No of patients	Percentage
Spleen	19	39.58%
Liver	18	37.5%
Kidney	6	12.5%
Pancreas	2	4.16%



Graph showing organ injury in USG abdomen.

CT SCAN:

CECT was performed in 36cases.

CECT scan:

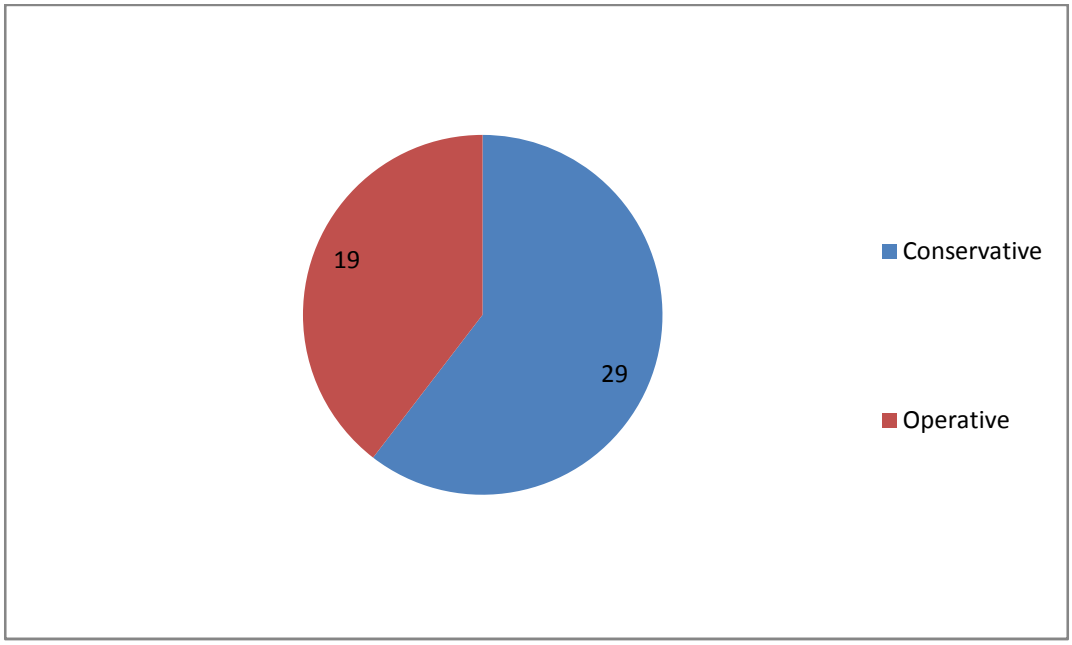
Organ injured	No of Cases
Spleen	15
Liver	14
Pancreas	3
Renal	7
Notdone	12

Those patients who did not underwent CECT either they were taken for laparotomy or hemodynamically unstable.

Ratio of operative to conservative treatment:

Treatment	No of patients	Percentage
Conservative	29	60.41%
Operative	19	39.58%

40% (19) of the patients underwent emergency laparotomy because of pneumoperitoneum or hemodynamic instability .29 patients were managed non Operatively because they had no signs of peritonitis and they were hemodynamically stable.



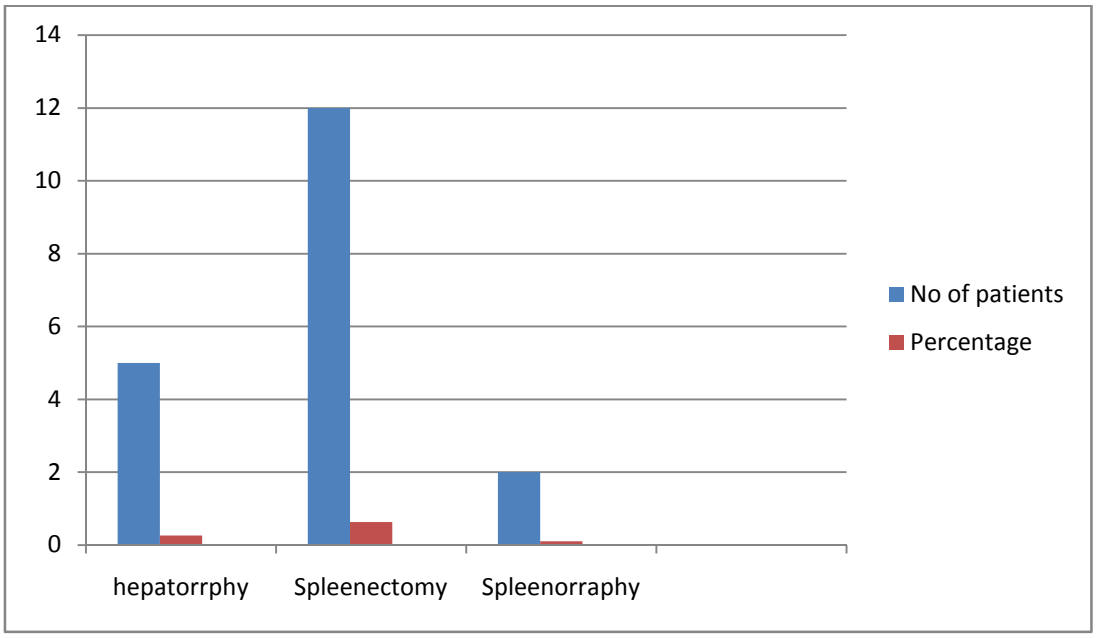
Graph showing ratio of operative to conservative treatment

TYPE OF SURGERY:

The below table shows various operative procedures carried out during exploratory laparotomy:

Type of surgery

Procedure	No of patients	Percentage
Hepatorraphy	5	26.31%
Spleenectomy	12	63.15%
Spleenorraphy	2	10.52%

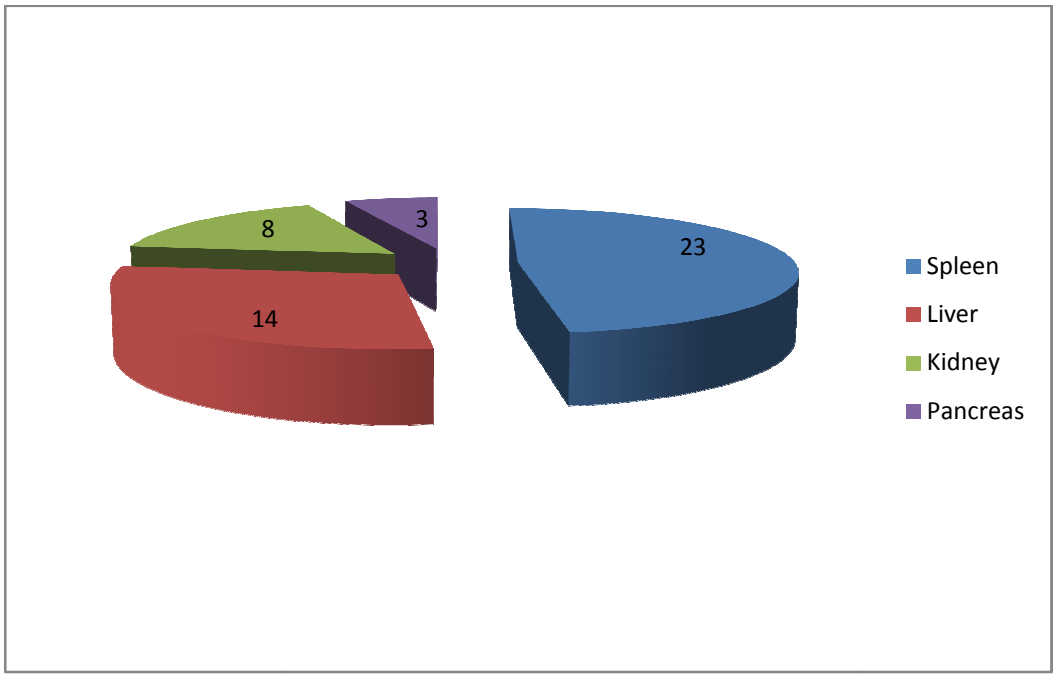


Graph showing type of surgery

ORGAN WISE INJURY:

Organ wise injury

Organ	No of patients	Percentage
Spleen	23	47.91%
Liver	14	29.16%
Kidney	8	16.67%
Pancreas	3	6.25%



graph showing organ wise injury

MULTIPLE ORGANS INJURED:

Organs injured	No of patients
Spleen+hollowviscus	4
Spleen+renal	2
Spleen+liver	2
Renal+hollowviscus	1
Spleen+Liver+renal	1
Liver+pancreas	2

Multiple organs are involved in our study as shown above.

COMPLICATIONS

Complications in patients undergoing surgery:

Post-op complications	No of patients
Wound infection	3
Respiratory complication	5
Wound dehiscence	1
Intra abdominalabscess	1

Complications in patients managed conservatively:

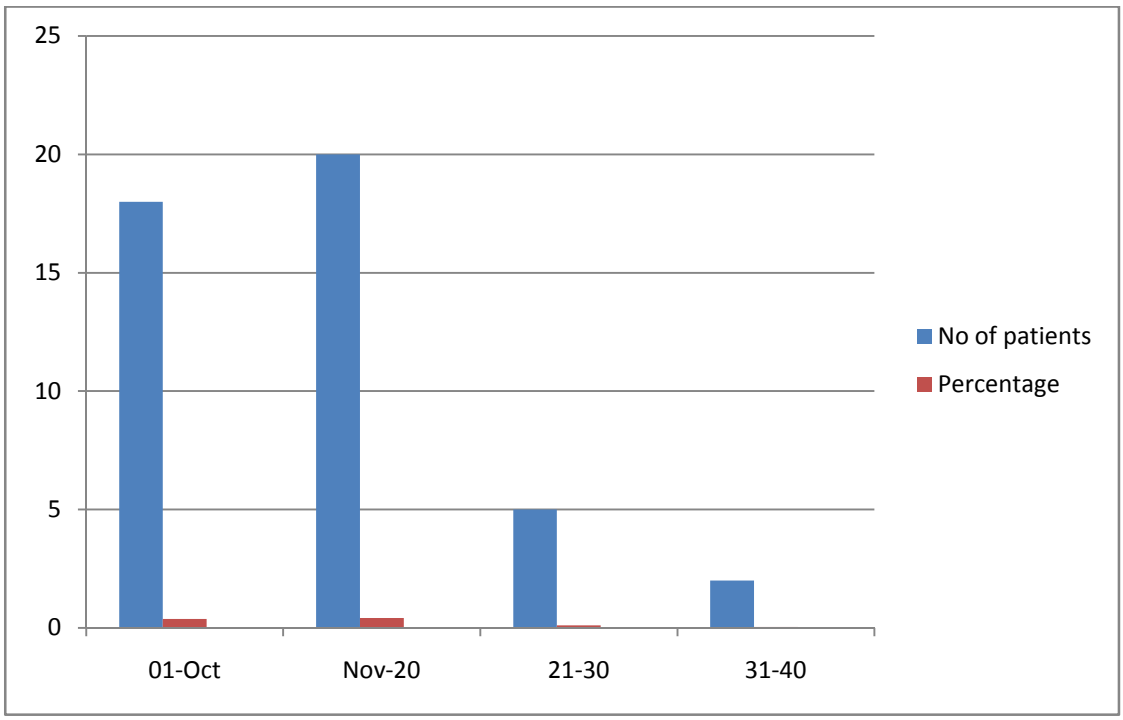
Complications	No of patients
Respiratory complication	3
Intra abdominal abscess	2

DURATION OF HOSPITAL STAY:

The range varied from 8-52 days. The mean range of stay in hospital is 16 days. The following table shows duration of stay:

Duration of hospital stay:

No. of days	No of patients	Percentage
1-10	18	37.5%
11-20	20	41.6%
21-30	5	10.4%
31-40	2	4.2%
41-50	2	4.2%
>50	1	2.1%



Graph showing duration of hospital stay

MORTALITY:

Total 7 patients died in the present study .3 belonged to operative group and died within 2-3 days of post operative period mainly due to hypovolemia or sepsis. 3 patients died during resuscitation.1 died due to severe head injury .Therefore mortality is14.6%

By statistical analysis got a p value of $p< 0.01$ which is significant . Hence patients with stable pulse rate , blood pressure , normal CVP and grade 1 and grade 2 splenic and liver injuries can be managed managed conservatively .

STATISTICAL ANALYSIS

Group	Mean	SD	No. of Patient
Conservative	2.12	0.3	29
Operative	1.14	0.25	19

T-Test for Equality of Means

t	df	Probability	Significant
15.5	60	0.01	**P<0.01**

P<0.01 significant at 1% level

DISCUSSION

Sex incidence:

Gender comparison

Gender	Our series	Davisetal25
Male	83.3%	70
Female	30%	30

From the above table it is clear that males are more common victims of blunt trauma abdomen when compared to Davis etal study[25]. The incidence is slightly more in males as males are involved in RTA and Assaults.

Age Incidence:

Age group- in our study majority of our study population belonged to 21-30 yrs of age followed by 31-40 yrs of age as young people are involved in RTA which is compared to Davis et alstudy [25]

Age comparison

Age group	Our study	Davisetal25
11-20	4.1%	19%
21-30	45.8	24%
31-40	29.2	15%
41-50	8.3	13%
51-60	8.3	6%
61-70	2.1	3%
71-80	2.1	-

MODE OF INJURY:

Cause	Ours tudy	Davisetal25	Khannaetal26
Road Traffic accident	56.2%	70%	57%
Fall from height	25%	6%	15%
Assault/injury with blunt object	18.8%	17%	33%

From above table it clearly states that RTA is the most common mode of injury because of increased number of vehicles recently. The young people also give priority to speed rather than safety.

Clinical presentation :

In our series abdominal pain was the most common presenting complaint accounting 90%. Abdominal distention was next most common presentation in 56% of cases. The signs and symptoms are misleading in case of blunt trauma abdomen and are masked by concomitant head injury, chest injury and alcohol consumption. Retroperitoneal organ injury was missed in DPL and USG abdomen. In Davis et al study25 43% had no specific complaints. So this emphasizes the importance of careful and continuing observation and repeated clinical examination of individuals with blunt trauma abdomen.

Head	12.5%	9%	12%
Thorax	33.3%	27%	24%
Extremities-fracture	20.8%	15%	27%
Pelvic fracture	6.2%	-	-
Soft tissue injury	4.1%	12%	-
No association	37.5%	-	-

Latent period: Latent period is the interval between the time of injury to presentation to our hospital. 41.7%of our patients presented between 7-2 hrs after injury. 31% presented within 6hrs after injury. This time lag is due to lack of facility for transport. Many belonged to rural area.

Associated injuries: Associated injury was present in 30 cases. The most extra abdominal injury was thoracic accounting for 53% followed by extremity fracture, head injury, pelvic fracture and soft tissue injury in descending order. There was no association in 18 patients. The above table shows comparison to present study.

Haemoglobin: Haemoglobin percentage was done in all cases out of which 23% of our study population had hemoglobin less than 8grams.

Hematocrit: Hematocrit value was done in 45 patients. It was < 30% in 44% of our study population. In 5 cases there was decreasing hematocrit on serial measurement and were taken for emergency laparotomy.

Urine microscopy: Urine microscopy was done in all cases. There was hematuria either macro/micro in 8 cases. All the cases showed renal injury on CT scan.

Plain X ray erect abdomen: Plain erect X ray of abdomen was done in 45 cases. Gas under diaphragm was found in 5cases. In Davis et al10 study abdominal X ray was abnormal in 21% cases. In our study it is abnormal in 23% of cases of BIA

Four-quadrant aspiration: FQA was done in 81% of cases. 62% showed positivity. In Davis et al study it was done in44% of cases. Out of these, 5 cases it was false negative.

Organ spleen is the most common organ injured in BIA as compared to international series, accounting to 40%, followed by liver in 37.5% cases and kidney in 12.5% cases.

Ultrasound examination (FAST) USG abdomen (Focussed Abdominal Sonography for Trauma) was done in all cases out of which 45 cases had solid organ injury. Therefore USG abdomen is more reliable in detectingsolid organ injury and free fluid in the abdomen. Imaging is essential in early decision making. Focussed Assessment with Sonography in Trauma (FAST) examination of pericardial, perihepatic, perisplenic and pelvic areas help in early detection of clinically significant abdominal injury. FAST examination can be performed repeatedly and is an excellent adjuvant to physical examination.

Treatment	No of cases	Percentage(%)
Conservative	29	60
Operative	19	40

CT scan abdomen: CECT was done in 36 cases. Rest of the patients which were managed conservatively, patients were not affordable and some were hemodynamically unstable and were taken for exploratory laparotomy.

Computed tomography (CT) can provide reliable information on haemoperitoneum, extent of solid organ injuries, retroperitoneal organ injuries, most cases of hollow viscus perforation and ongoing bleeding by means of radiographic blush.

Ratio of operative to conservative treatment: There is an increase in trend towards conservative management if the patient is hemodynamically stable. The grade of injury was assessed by CECT and was helpful in planning the management. Minor lacerations and capsular tears which are difficult to diagnose clinically can be easily demonstrated in CECT scan and were selected for non-operative management. However the disadvantage of non-operative management is missed injuries resulting in increased morbidity and mortality.Hence patients

undergoing conservative management are to be under vigilant monitoring for atleast 72 hours .

Multiple organs injured

Organ injuries	No of patients	Percentage(%)
Spleen+ hollow viscus	4	8.3
Spleen + renal	2	4.2
Spleen +liver	2	4.2
Renal+ hollow viscus	1	1.2
Spleen+ liver+renal	1	1.2
Liver +pancreas	2	4.2

Total 25%

Patients who are treated conservatively are closely monitored . Abdominal pain , abdominal distension using abdominal girth chart , pulse rate , blood pressure , central venous pressure were monitored serially .

Above table shows incidence of multiple organ injuries in our study. In 25% of cases there was multiple organ injury in the abdomen.

Operative procedure: In the present study, Splenectomy was done in 12 cases because of hemodynamic instability and severity of injury. Splenorraphy was done in 2 cases and most of liver injuries were

managed conservatively. Hepatorraphy was done in 5 case. All renal injury cases were managed conservatively. Drainage procedure was done in 2 patients of pancreatic injury.

Mortality: Total 7 patients died in our study. 3 patients belonged to operative group. They died in post operative period, majority of them died due to septicaemia, 3 patients died during resuscitation. 1 patient died due to severe head injury .Therefore mortality in the present study is 14.6% which is on par with the other published studies in our country (Khanna et al26). The mortality rate in Di Vincentiet al29 study was 23%.Cox et al13 study reports mortality of 10% and in Davis et al25 study it was 13.3%.

SUMMARY

Summarizing the findings of the study, details furnished here are in accordance with the renounced statistics.

This is a prospective study of 48 cases of blunt abdominal trauma conducted in CMCH from august 2013- august 2014. Males (83%) outnumbered females (17%). The most common age group affected is of 21-30years which forms the young and reproductive group.Road traffic accident forms the most common mode of injury (56.2%).Majority of our study population (90%) presented with pain abdomen followed by abdominal distention (56%). The latent period in our study was < 18 hours in 90% of cases. Hemoglobin and hematocrit value becomes handy in treating BIA injury. X ray erect abdomen and chest X ray forms important investigational tools. Ultra sonography (FAST) has picked up solid organ injury or collection in 90-95% of cases. So it becomes an important tool in emergency set up, more so in hemodynamically unstable patients. Four quadrant aspiration is a simple and non specific for diagnosis.DPL was done in small number of patients since facility of high resolution ultrasonography(FAST) was available in our institution. CECT abdomen was performed in 75% of study population and had pivotal role in deciding operative or conservative management in

hemodynamically stable patients.The most common injured organ in the present study is spleen followed by liver, kidney, and pancreas in the decreasing order. For splenic injury, most common surgery performed was Splenectomy in 7 patients followed by splenorraphy in 2 patients. Rest was all managed conservatively. Liver injuries were managed conservatively most of the times and hepatorraphy was done in 5cases. Retroperitoneal hematoma was seen in a small proportion of patients associated with renal injuries and were treated conservatively. Multiple intra abdominal organs were involved in our study accounting for 25%. Associated extra abdominal injuries like head , thoracic and orthopedic injuries were found in 30 cases in the present study and influenced the morbidity and mortality of the patients. Patients with stable vitals can be managed conservatively with serial monitoring of vitals and repeat ultrasonogram. Post operative wound infections and respiratory complications were responsible for majority of long hospital stay in ours study. The present study showed a mortality of 14.6%.

CONCLUSIONS

Following conclusions can be drawn from our study:

- Blunt injury abdomen with solid organ injury forms considerable load of patients in our surgical ward admissions.
- Most common age group involved is 21-30 years. Predominantly males are affected in large proportions.
- Road traffic accident forms the most common mode of injury. So efforts should be made to bring road traffic regulations into strict action and traffic norms regulated.
- Well established trauma care centres should be established at every Taluk hospital. Measures for early transport of the patients from the accident site to the trauma centres should be undertaken.
- Significant number of cases will have associated injuries with blunt injury abdomen like head injury, thoracic injury, extremity fractures.
- Clinical presentation is varied, sometimes confusing.

- Blunt injury abdomen is usually less obvious. Hence, repeated examination by multi specialty personnel in a specialized trauma centre is required.

- Erect abdomen X ray is a useful investigation to identify associated hollow viscus injury.

- Falling titres in serial hematocrit value indicates ongoing bleeding.

- With the advent of high resolution ultrasonography (FAST), DPL and four quadrant aspiration blood investigations are becoming less opted.

- CECT forms the core investigation of choice in dealing with blunt injury abdomen patients ,and becomes more important in deciding operative versus conservative management.

- Early diagnosis and repeated clinical examination and use of appropriate investigations forms the key in managing Blunt abdominal injuries.

- Conservative management of liver and splenic injuries can be done in patients with stable vitals and grade 1 and grade 2 splenic and liver injuries .

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BLUNT TRAUMA ABDOMEN

PROFORMA

Patient details: Case no: I P no: Unit

Name: Age: Religion:

Occupation: Address:

Injury on: Admission on:

Operated on: Discharged on:

Expired on:

Presenting complaints:

Injury: Time: Place:

Mode:- Road Traffic Accident/ Assault/ Fall

Events that followed**:**

History of present illness:

PAIN ABDOMEN: Onset: Time ,mode ,Duration, Site

VOMITING : Duration: Relation to pain: Freqency and quantity , Character of Vomitus

DISTENSION OF ABDOMEN :Duration/Uniform or localized/ Associated bowel disturbances/ Micturition disturbance/ Retention of urine/ Hematuria

Any other complaints:

Associated injuries if any:

Previous history:

Personal history:

EXAMINATION:

General physical examination:

Consciousness/Hydration/Pulse/Blood pressure/Respiratory rate/ Pallor/ Decubitus/ Temperature/ Shock signs/ Icterus/ Surgical emphysema/ ENT bleeding

PER ABDOMEN EXAMINATION:

Inspection : Shape/ Skin over abdomen/ Visible injuries/ Prominent swellings/ Hernial orifice/ Movement with respiration

Palpation: Temperature/ Tenderness/ Girth of abdomen/ Guarding/ Rigidity

Percussion: Liver dullness/ Splenic dullness/ Shifting dullness/ Fluid thrill

Auscultation :Bowel sounds/ Bruit

External genitalia:

Per rectal findings:

Associated injuries: Head and neck

Thorax: ribs, hemopneumothorax

Spine

Pelvis

Extremities

Systemic examination:

Respiratory system:

Cardiovascular system:

Central nervous system:

Provisional Diagnosis:

Investigations:

U S G ABDOMEN:

Blood: serial Hb%: serial Hematocrit:RBC:

Grouping: T C: DC

Urine :color: clarity: albumin:

Sugar: Microscopy:

SERUM: Amylase:Bilirubin

Electrolytes:

X ray: Erect Abdomen/Chest/Pelvis/Spine

Four quadrant aspiration: Quantity/ Character/ Microscopy/ Amylase level

FAST:

CECT SCAN abdomen:

Management:

Conservative: Fluids given:

Blood transfusion:

Operative:

If operative: Date/ Started and ended/ Anesthesia/ Operative findings

Final diagnosis:

Post mortem findings in case of death:

Follow up:

ஒப்புதல் படிவம்

பெயர் :

பாலினம் : வயது :

முகவரி :

அரசு கோவை மருத்துவக் கல்லூரியில் பொது மருத்துவ துறையில் பட்ட மேற்படிப்பு பயிலும் மாணவன் அவர்கள் மேற்கொள்ளும் **"கூர்மையில்லாத உபகரணங்களால் அடிபட்டு வயிற்றுப் பகுதியில் ஏற்படும் கெட்டியான உடல் உறுப்புகளின் காயங்களுக்கு அறுவை சிகிச்சை மற்றும் அறுவை சிகிச்சை இல்லாத மருத்துவமுறைகளை ஒப்பிட்டு ஆராய்தல்"** குறித்த ஆய்வில் செய்முறை மற்றும் அனைத்து விவரங்களையும் கேட்டுக் கொண்டு எனது சந்தேகங்களை தெளிவுப்படுத்திக் கொண்டேன் என்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடன், சுய சிந்தனையுடனும் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த ஆய்வில் என்னுடைய அனைத்து விபரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதை தெரிவித்துக் கொள்கிறேன். எந்த நேரத்தில் இந்த ஆய்விலிருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

இடம் : கையொப்பம் / ரேகை

நாள் :

KEY TO MASTER CHART

M	-	Male
HB%	-	Haemoglobin%
ND	-	Not Done
BIA	-	Blunt Injury Abdomen
IAB	-	Intra abdominal Abcess
F	-	Female
N	-	Normal
DPL	-	Diagnostic Peritoneal Lavage
Lap	-	Laparotomy
I	-	Improved
RTA	-	Road Traffic Accident
RBC	-	Red Blood Cell
US	-	Ultrasound
ICD	-	Intercostal Drainage
LP	-	Latent Period
AB	-	Abnormal
Lac	-	Laceration
NA	-	Not Applicable
UK	-	Unknown
AUD	-	Air under Diaphragm
HP	-	Hemoperitoneum
B/L	-	Bilateral

#	-	Fracture
NAD	-	No Abnormality Detected
Morri	-	Morrison pouch Com-Complication
HI	-	Head Injury
GG	-	Ground Glass
CT	-	Computed Tomography
POWinf	-	Post Operative Wound infection
Lt	-	Left
abd	-	Abdomen
Gr	-	Grade
I	-	Improved
Rt	-	Right
FQA	-	Four Quadrant Aspiration
jeju	-	Jejunum
Resp	-	Respiratory

S.No	Name	I.P. No	Age	Sex	Duration of Stay (days	Mode of Injury	L Pinhrs	Shock	Associated Injuries	Hbgm%	Hematocrit	Urine	Plain X-ray abd	FQA	DPL	US Scan	CT Scan	Clinical Diagnosis	Lap findings	Operative Procedure	Postopcomp & Outcome
1.	Selvaraj	14520	57	M	9	RTA	10 hrs	-ve	Nil	8.9	40%	N	AB	+	ND	Liver lac	Gr III liver injury	Liver injury	ND	ND	I
2.	Muji	14600	40	M	1	RTA	UK	-ve	th (Lt) 9-10 rib #	9.9	29%	N	AUD	+	ND	Splenic lac	ND	BIA with splenic lac+jeju injury	Jeju perforation + perisplenic hematoma	Closure of perforation + Lav	Sepsis + Death.
3.	Naseena	14968	37	F	23	RTA	8 ½ hrs	+	Lt hemothorax	9.0	27%	N	ND	ND	ND	Mod HP + ? splenic lac	Gr IV splenic injury, mesentery tear +	BIA	Splennic lac, Mes tear.	Splenectomy with closure of mes.+ICD	POW inf + Resp comp I
4.	Selvam	16789	55	M	25	RTA	12 hrs	-ve	None	10	23%	N	GG + AUD	+	ND	Mod HP + splenic lac	Mesenteric tear Gr IV splenic injury	BIA	Complete disruption at hilum	Laparotomy + primary closure of perforation	POW inf Death
5.	Soundarraj	19760	57	M	15	RTA	12 hrs	-ve	-	10.49	46%	N	GG	ND	ND	Mod HP +? splenic injury	Splenic injury Gr IV	BIA with splenic injury	ND	ND	Resp comp
6.	Kaviraj	21668	29	M	11	Injury with blunt object	10 hrs	-ve	Pelvic #, Rt Humerus #	9.9	22%	N	NAD	ND	ND	Mod HP	Splenic injury Gr III	BIA with splenic injury	Splenic lac + EPR B	Lap with splenectomy with lavage	I
7.	vijayakumar	24116	37	M	8	Fall from building	7 ½ hrs	-ve	None	11	ND	N	GG	+	ND	Liver injury with mod HP	Liver Gr III inury	BIA	ND	ND	IAB
8.	Vignesh	28766	19	M	13	RTA	6 ½ hrs	-ve	None	10.6	40%	N	GG	ND	ND	Significant HP with liver lac	Gr IV liver injury	BIA	ND	ND	I
9.	Amith	30887	26	M	15	RTA	16 hrs	-ve	Rt 7-8 rib #	9.8	ND	N	GG	-ve	ND	Mod HP	Gr III liver injury	BIA	ND	ND	I
10.	Subramani	31667	35	M	17	Fall from height	16 hrs	-ve	Pelvic #	8.9	46%	Alb + RBC +	AB	- ve	ND	Rt kidney contusion	Rt kidney Gr II injury	BIA with rt kidney injury	ND	ND	I
11.	senthil Kumar	322567	23	M	1	RTA	12 hrs	+	th th Lt 8 , 9 Rib #	8.6	23%	Hematuria	GG	ND	ND	Significant HP + ? splenic injury	Spenic injury gr III, renal lac gr III	BIA	ND	ND	Death
12.	Sujimohan	33554	25	M	13	Assault	10 hrs	-ve	-	8	47%	Albtraces, Pus 6-8, RBC ++	AB	-ve	ND	B/L renal contusion	Renal injury, Rt Gr II, Lt Gr I	BIA with B/L renal contusion	ND	ND	I
13.	Antony	354271	25	M	51	Injury with blunt object	4 hrs	+	th th Rt 7 rib #, Lt 9 rib #	10	29%	Micro hematuria, protein +	GG	+	ND	Mod HP with ? liver injury, ? splenic injury	Gr III liver injury, Gr III splenic injury, Gr V renal injury, rt hemothorax	BIA	Liver lac, splenic lac, renal lac, rt side severe HP	Lap with splenectomy with hepatorraphy	I
14.	Murugananthan	35780	25	M	17	Assault	6 hrs	-ve	th 5,6 rib #	13.5	47%	N	AB	-ve	ND	Liver contusion with mild HP	Liver Gr II injury	BIA with liver injury	ND	ND	I
15.	Thamburasu	37654	26	M	7	RTA	4 hrs	-ve	Lt radial #	11	27%	N	AUD	ND	ND	Mild HP, ?splenic lac	Gr III splenic injury	BIA with lt radial #	Perisplenic hematoma + jeju perforation	Closure of perforation	I
16.	Ramesh	38457	35	M	32	RTA	8 hrs	+	th th Lt 6 -8 rib #	8	22%	N	GG	+	+	Splenic lac	Gr III splenic injury	BIA with splenic lac	Splenic lac with HP	Lap with splenorraphy+ lavage	Resp comp
17.	Goruvayuruppan	38553	40	M	8	RTA	12 hrs	+	th th Lt 8 -9 rib #	7	25%	N	GG	+	ND	Mod HP	ND	BIA with splenic lac	HP + splenic lac with bleeding	Lap with splenectomy	I
18.	Subramani	39748	50	M	9	RTA	8 hrs	-ve	Rt # tibia	11	45%	N	GG	ND	ND	Splenic lac	Gr II splenic injury	BIA with splenic lac	ND	ND	I
19.	Chinnasamy	40345	24	M	18	Fall from height	6 hrs	-ve	th Lt 5-6 rib #, rt radius #	6	46%	N	GG	+	ND	Mild collection + ? splenic injury	ND	BIA with splenic lac	ND	ND	I

20.	**Palanisamy**	**41535**	**35**	**M**	**8**	**RTA**	**8 hrs**	**-ve**	**Lt radius #**	**10**	**45%**	**N**	**NAD**	**ND**	**ND**	**Splenic lac**	**Gr III splenic injury**	**BIA with splenic l ac**	**ND**	**ND**	**Resp comp**
21.	**Venkatesh**	43582	**42**	**M**	**19**	**Assault**	**14 hrs**	**+**	**Nil**	**11**	**28%**	**N**	**GG**	**+**	**ND**	**Liver lac**	**Gr IV liver injury**	**BIA with liver lac**	**Lap**	**Hepatorraphy**	**I**
22.	**Ramesh**	44215	**15**	**M**	**14**	**RTA**	**10 hrs**	**-ve**	**Mild HI, rt thigh hematoma**	**9**	**27%**	**N**	**GG**	**-ve**	**ND**	**Splenic + liver lac**	**Gr II liver injury + Gr III splenic injury**	**BIA with splenic and liver lac**	**ND**	**ND**	**I**
23.	**Anitha**	45534	**65**	**F**	**20**	**Assault**	**5 days**	**-ve**	**th # rt 7-8 rib**	**10**	**38%**	**N**	**GG**	**-ve**	**ND**	**Liver contusion**	**Gr I liver injury**	**BIA + liver contu sion**	**ND**	**NA**	**I**
24.	**Aysama**	48665	**75**	**F**	**8**	**Assault**	**24 hrs**	**-ve**	**-**	**10**	**29%**	**Hematuria +**	**AUD, GG**	**ND**	**ND**	**Rt renal contusion**	**Rt kidney Gr II injury**	**BIA with renal contusion**	**Jejunal perforation, rt renal contusion**	**Lap + lavage + perforation closure**	**Resp comp Death**
25.	**Subramani**	49654	**27**	**M**	**9**	**RTA**	**17 hrs**	**-ve**	**Rt shoulder dislocation**	**9**	**45%**	**N**	**AB**	**ND**	**ND**	**Splenic contusion**	**Gr I splenic injury**	**BIA with splenic contusion**	**ND**	**ND**	**I**
26.	**chinnasamy**	50115	**22**	**M**	**7**	**RTA**	**6 hrs**	**-ve**	**Mild HI**	**13**	**45%**	**Hematur ia +**	**ND**	**+**	**ND**	**Splenic injury +**	**ND**	**BIA with splenic lac**	**ND**	**NA**	**I**
27.	**Sampathkumar**	51265	**24**	**M**	**9**	**RTA**	**6 hrs**	**-ve**	**Nil**	**8.5**	**46%**	**N**	**AB**	**+**	**-ve**	**Liver lac**	**ND**	**Liver injury**	**ND**	**ND**	**I**
28.	**Parthasarathy**	52423	**38**	**M**	**14**	**Self fall**	**24 hrs**	**-ve**	**th Lt rib 10 #**	**7**	**46%**	**N**	**AB**	**+**	**ND**	**Splenic lac**	**Gr I splenic injury**	**BIA with splenic l ac**	**ND**	**ND**	**I**
29.	**Jaya**	**52365**	**30**	**F**	**19**	**RTA**	**8 hrs**	**-ve**	**Rt femur #**	**10**	**34%**	**N**	**NAD**	**+**	**+**	**Liver + pancreatic lac**	**Liver gr III, pancreas Gr I**	**BIA with liver and pancreatic injury**	**ND**	**ND**	**IAB**
30.	**Murugan**	**52445**	**21**	**M**	**17**	**RTA**	**3 hrs**	**-ve**	**Rt femur #**	**8.5**	**45%**	**N**	**NAD**	**ND**	**-ve**	**Mod HP + ? splenic injury**	**ND**	**BIA with splenic injury**	**ND**	**NA**	**I**
31.	**Yaseer**	**52554**	**34**	**M**	**8**	**RTA**	**5 hrs**	**-ve**	**Rt tibia #**	**11**	**37%**	**Hematur ia**	**AB**	**ND**	**ND**	**Rt renal contusion**	**Rt Gr I renal injury**	**BIA with renal injury**	**ND**	**NA**	**I**
32.	**Karthick**	**52654**	**30**	**M**	**28**	**RTA**	**8 hrs**	**-ve**	**Mild HI**	**8**	**46%**	**N**	**GG**	**+**	**+**	**Mild HP with splenic injury**	**Gr II splenic injury**	**BIA with splenic injury**	**ND**	**NA**	**I**
33.	**Maran**	**52699**	**58**	**M**	**9**	**Assault with blunt object**	**2 hrs**	**-ve**	**None**	**9**	**45%**	**N**	**NAD**	**-ve**	**ND**	**Liver contusion**	**Gr I liver injury**	**BIA with liver inj ury**	**ND**	**NA**	**I**
34.	**Avinashi**	**52712**	**30**	**M**	**11**	**RTA**	**12 hrs**	**-ve**	**Rt humerus #, rt th th 5 6 rib #**	**9**	**41%**	**N**	**NAD**	**ND**	**ND**	**Liver lac**	**ND**	**BIA with liver lac**	**ND**	**NA**	**I**
35.	**Jai**	**52832**	**24**	**M**	**16**	**Fall from tree**	**10 hrs**	**+**	**-**	**10**	**ND**	**N**	**NAD**	**ND**	**ND**	**Liver lac**	**Gr IV liver injury**	**BIA with liver lac**	**Lap**	**Hepatorraphy**	**I**
36.	**Abdul basha**	**52931**	**28**	**M**	**4**	**Fall from height**	**12 hrs**	**-ve**	**T10 # of vertebr a**	**8.8**	**26%**	**N**	**GG**	**++**	**+**	**? pancreatic injury + ? liver inury**	**Gr IV pancreatic injury + Gr III liver injury**	**BIA with pancreatic injury**	**Complete transecti on at body region**	**Distal pancreatecto my + drainage**	**Pt expired after 4 days abscess with sepsis**
37.	**Madhavan**	**53030**	**32**	**M**	**42**	**Self fall**	**22 hrs**	**+**	**Nil**	**11**	**43%**	**N**	**AB**	**+**	**ND**	**Free fluid in Morri pouch**	**ND**	**BIA**	**Liver lac**	**Lap + hepatorraphy**	**Resp comp, wound dehiscence +**
38.	**Ajay siva**	**53105**	**35**	**M**	**26**	**Assault**	**4 hrs**	**-ve**	**th Rt 5-7 rib #**	**9**	**45%**	**N**	**ND**	**ND**	**ND**	**Liver lac, mesenteric hematoma**	**ND**	**BIA with liver inj ury**	**ND**	**ND**	**I**